MAY 18, 1959

Price 50 cents

R and D RESEARCH and DEVELOPMENT news issue

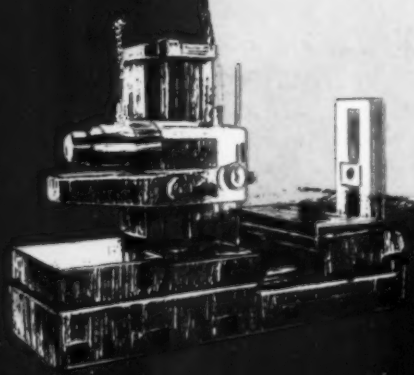
Product Engineering

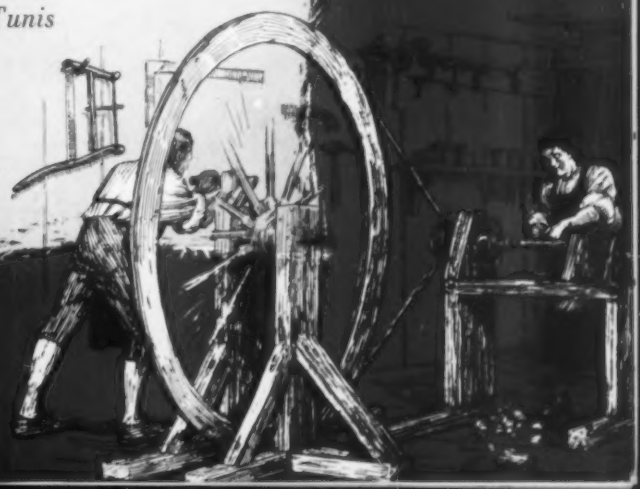
McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

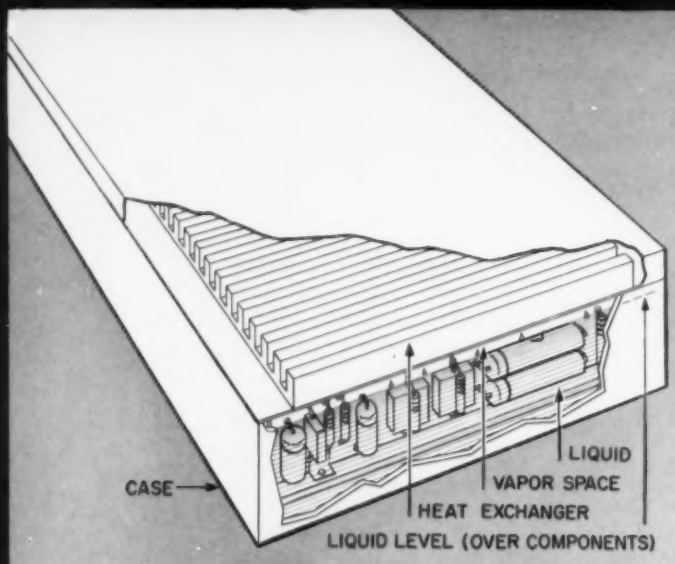
does AMERICA have a DESIGN HERITAGE?

The forces that shape our products are debated by these American and foreign designers, engineers, architects and artists . . . *see page 36*

- *Henry Dreyfuss*
- *George W. Walker*
- *Philippe Charbonneaux*
- *Sori Yanagi*
- *Olin J. Stephens II*
- *Frank Lloyd Wright, 1869-1959*
- *Robert E. Bruckner*
- *Edward C. Wells*
- *George D. Culler*
- *Edwin Tunis*







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IN THE DESIGN OF HIGH HEAT-DENSITY ELECTRONIC EQUIPMENT

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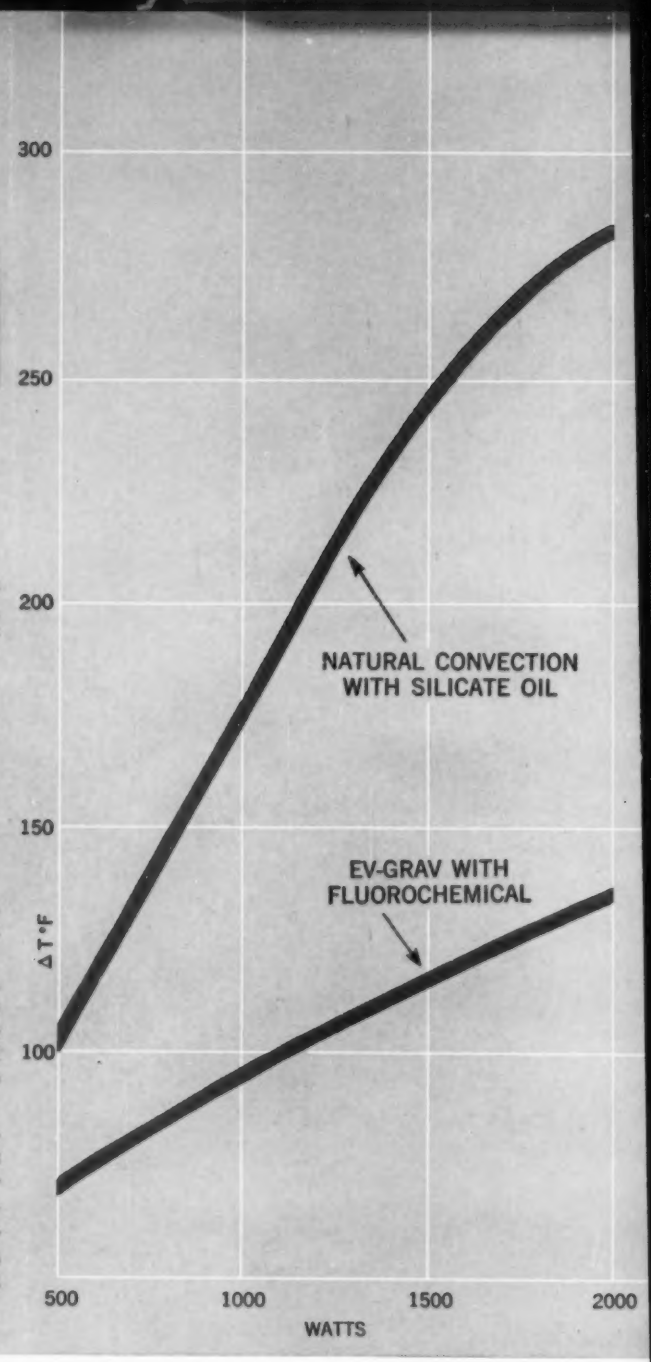

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Product Engineering Editors will be at every conference session, they'll be visiting every booth, evaluating every new development.

And in the June 8 Design issue you'll find their full-scale report of the conference discussions, the components, materials, finishes, techniques exhibited.

Visit us at our booth (#1300) and watch for our . . .

Report of the Design Show in the June 8 issue.

coming next week

the DESIGN issue for May 25

FEATURING

- **Higher-energy batteries**
  Electrochemical couples may give power packs 1/10 as heavy as today's best.

- **New oilless bearings**
  A plastic-base material offers high load capacity and low coefficient of friction.

- **Before tackling the refractory metals**
  What you should know about handling tantalum, molybdenum, tungsten, columbium.

- **A workable approach to gear tolerances**
  The other side of the precision controversy.

- **Criteria for a tight gasketed joint**
  Latest research shows how typical gasket materials behave in aluminum-steel joints.

- **Criteria for readable panel markings**
  Lettering, placement and information content of labels, counters, legends, identifying tags.

- **Stress-concentration factors for thin-wall cylinders**
  Formulas and examples show how correct maximum stresses can quickly be found.

- **How to align mating parts**
  9 more ways supplementing those that appeared in last week's Design issue.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news issue

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Any tradition, good or bad, will affect the shape and effectiveness of products to come. Here are the interpretations of ten American and foreign artists, designers, engineers and architects.

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R and D Research and Development news issue

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● **All this talk of a design heritage** (p 36) is a bit highbrow to one mobile-equipment manufacturer we know. When asked about the philosophy and method behind his latest design he answered incredulously, "How would you go about describing the engineering on a Brunswick Stew? We take critical dimensions, add to that our rule-of-thumb applications and check the result of stresses. We throw in the application of hydraulics together with a few pins and beams and flanges and we weld it all together and test it with a load to see if it all comes out ok. If it comes out good and handles the load in accordance with design and weight requirements, we feel like a good chef when the stew turns up tasting good."

● **Taxpayers invariably groan** at the thought that every rocket shoot, successful or not, burns up nearly a million dollars at the touch of a red button. Someone calculated that freight rates from earth to a minimum satellite orbit are about $30,000 a pound. An aircraft company wag has already been quoted on this high cost of lifting . . .

● **The romance of trains** seems to be dead in the US (p 21) for kids as well as grown up designers. Not one highschool student at the National Science Fair exhibited anything so slow moving. We asked one of our staff editors to take a look a couple of weeks ago and her official report appeared in the Apr 27 issue on p 26. But unofficially she reported that now she knows how engineers get started down the thorny path. Seems she roomed with a Brooklyn gradeschool teacher four or five years ago and every afternoon, over before-dinner martinis, they'd think up new projects for the brightest kid in the class who was on the verge of becoming a real delinquent. In desperation the teacher sent him off to the Brooklyn Museum of Science one day and—you guessed it—now he's one of 10 winners (out of 4000 entrants) to represent New York City in the Nationals this month.

ABP MAY 18, 1959 **PRODUCT ENGINEERING** *A McGRAW-HILL PUBLICATION* Vol. 30, No. 20 ABC

PRODUCT ENGINEERING is published weekly—with an additional Design Digest Issue in Mid-September, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription or change in address.

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United States subscription rates for individuals in the field of the publication, $5.00 per year, single copies 50 cents; Canadian subscription $7 per year; foreign $25 per year, payable in advance. Second-class postage paid at Albany, N. Y. U.S.A.

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SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfilment Manager, PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Fulfilment Manager promptly of any change of address giving old as well as new address, and including postal zone number if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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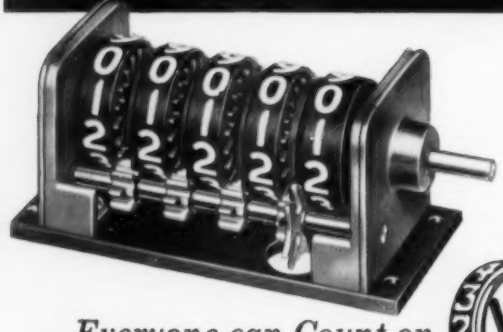

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DEVELOPMENTS TO WATCH...

American

Chemical gas-turbine efficiency can be doubled . . .

. . . to the point where it will probably compete with the fuel cell, for space-vehicle applications at least, say engineers at Sundstrand Turbo, Pacoima, Calif. Reliability of such low-power, partial admission turbines using expanded hydrazine or ethylene oxide is already better than 99%, and thermal efficiency above 50%, Sundstrand engineers report; and they feel the improvement in performance achieved in the past 7 years, amounting to a factor of 3 or 4, can be increased as much again.

Special nuclear materials, now available . . .

. . . on a commercial basis, may hold the answer to design problems in other fields. These are materials adjusted for neutron absorption or specially formulated to reduce radiation hazards and damage.

Two recent examples are a low-cobalt stainless steel and a high-boron type, both from Universal Cyclops Steel. The first, for structural use, holds cobalt to the barest minimum because of the high level of radioactivity it acquires when exposed to neutron irradiation, and because it has a rather high neutron absorption coefficient. Basically, this steel is a Type 304 L. But the cobalt content, normally 0.05 to 0.2, is held to less than 0.002%.

The second special stainless, for use in nuclear control rods, deliberately ups the content of boron, one of the highest neutron absorbers of them all, to produce a material that will gobble up these important particles and help shut off the nuclear reaction. This, too, is a 304 L stainless, but additional boron is supplied, bringing the total content to about 2%.

Both types are available in limited quantities in semifinished form, and UC is ready to accept commercial mill orders.

New starts and added starters . . .

. . . to the list of companies developing electric cars (*PE*—Jan. 19, p 7), industrial fabrics (*PE*—Feb. 10, '58, p 16), and precision time-frequency standards (*PE*—Mar 23, p 9), are these who have announced plans within the past month:

• Atlantic City Electric Co is revealed as one of the sponsors of the Charles Town-About, electric car being made by Stinson of San Diego. ACE will get delivery of the first models, expects soon to have them under test.

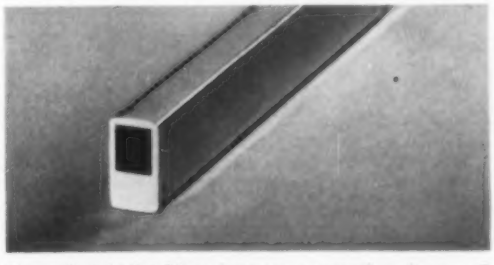
Meanwhile, American Motors and Sonotone have teamed up to develop a battery system that will extend the present 100-mi limit imposed by recharging needs; or, at least, reduce recharging time.

• Electric Storage Battery Co, already well into the electric-car field, is now turning its attention in another direction: industrial fabrics. Outgrowth of its research on porous materials for battery separators is a joint venture with Reeves Bros Inc to develop new moisture transmission membranes and other porous elements.

• Growing demand for accurate frequency standards, plus interest in solar-powered equipment, sparked development of "the world's smallest crystal clock" (it's less than 5 in. high) by Patek Philippe of Switzerland. Winner of a miniaturization award, the clock is designed for operation either by a 1.25-v battery or a solar cell, has a frequency-divider and time-indicator, and is said to be accurate to 1 to 2 millionths of a sec over a 24-hr period.

Off-center copper tubing . . .

. . . designed to replace drilled bar stock and brazed bar and tube assemblies, will soon be offered by Phelps Dodge Copper Products Corp, ACP Div, 300 Park Ave, New York 22. Said to offer high conductivity and high strength, it's made by cold drawing, and will be available in oxygen-free and electrolytic copper. Square and rectangular sizes up to 3 in. are currently being tested. Variations in shape profile, and sections with two holes are now under development and will be tested shortly—ARG



New electrical tubing features rectangular shape, off-center hole, will soon be available commercially.

La Salle fatigue-proof™ STEEL BARS

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uniform properties

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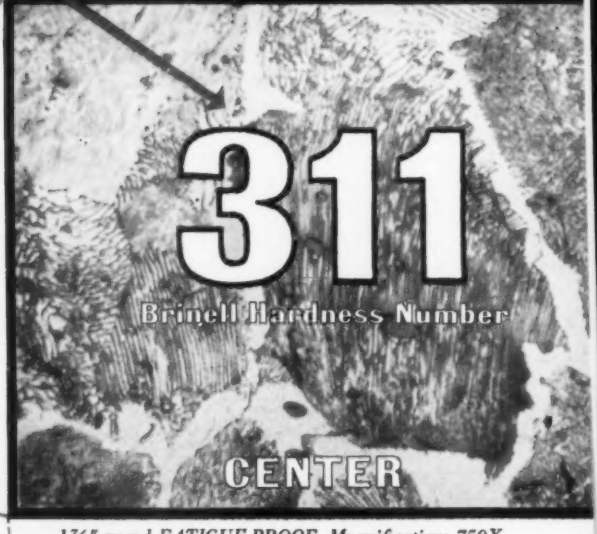

1⅜" round FATIGUE-PROOF. Magnification: 750X

The microscope shows the uniformity of FATIGUE-PROOF. Its uniformly pearlitic structure parallels its uniformity of properties from the surface to the center of the bar.

FATIGUE-PROOF strength and hardness are developed by "e.t.d." (Elevated Temperature Drawing). Unlike quenching and tempering, its effect is the same from surface to the center of the bar. It works a large bar as uniformly as it does a small bar.

There is no mass effect.

The microscope proves it. Surface, center, or mid-radius, FATIGUE-PROOF is pearlitic. There are no mixtures of bainite, martensite, and pearlite. FATIGUE-PROOF is uniform bar to bar, size to size, and lot to lot.

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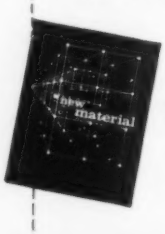

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DEVELOPMENTS TO WATCH...

World-wide

Why not a standard gallon? . . .

. . . Canadians are asking. They're men-in-the-middle in a situation that has been labeled hopeless. But, now that the US and UK have standardized the inch and pound *(PE—Jan 19, p 16)*, Canadians urge that liquid measures—the quart and pint as well as the ounce—be re-examined too.

Source of the trouble is the fact that the British gallon is a giant compared to that of the US. The name is the same, but the British unit is 1.2 times the size of the American, with quarts and pints diverging by similar amounts.

The last International Conference on Weights and Measures tabled the problem, saying "the standard US gallon and the British imperial gallon are so substantially different that a compromise international gallon is not practicable." But there'll be another conference next year, and the Canadians are planning to press for action.

Plastics that can serve as semiconductors;

. . . and semiconductors that can serve as photographic emulsions are among recent Soviet claims.

With the help of highly sensitive paramagnetic resonance instruments (EPR equipment: *PE—Dec 15, '58, p 10*), says Academician Semyonov, "Astonishing properties of certain polymers were discovered . . . properties that make it possible to synthesize polymers whose molecules reveal properties of semiconductors." We are already producing plastic magnets and scintillation counters but these claims by Semyonov—a Nobel Prize winner—may indicate further progress. He says introduction of metal atoms into nitrogen-bearing molecules does the trick.

The photographic emulsions, developed in Lithuania, are said to be capable of reproducing X-ray images and to be adaptable for copy duplication in electrostatic machines. This seems to resemble our own xerographic techniques. One interesting extension, though, is study of the effects of strong electric fields on the semiconductor-coated paper, with a view to using such paper as a replacement for crystal diodes and for special recording elements.

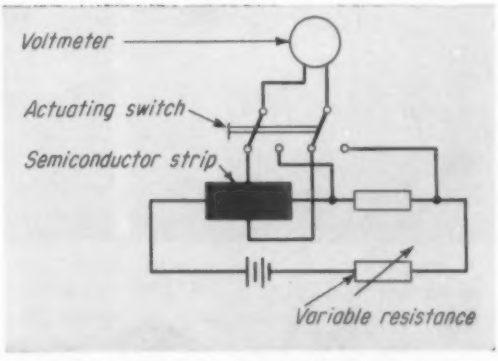
A nitriding process 1000 times as fast . . .

. . . as those now in use is claimed by metallurgists at the Latvian Academy of Sciences. Using high-frequency current to generate temperatures in the 1400-1500 F range, they say it is possible to feed aluminum chloride into the nitriding furnace, obtain atomic nitrogen, and attain good penetration of the steel surface in less than two minutes. Results, they say, are comparable to those obtained with 40- to 60-hr soaking processes now in use, and should permit design of fully automated production lines.

Semiconductor simplifies magnetic field measurement . . .

. . . in an instrument developed by Siemens & Halske, Erlangen, West Germany. It's a portable instrument that takes advantage of the Hall effect *(PE—May 4, p 30)*. By measuring the difference in potential which a magnetic field creates when it is imposed on a semiconductor strip carrying a current of known intensity, the strength of the field itself can be determined.

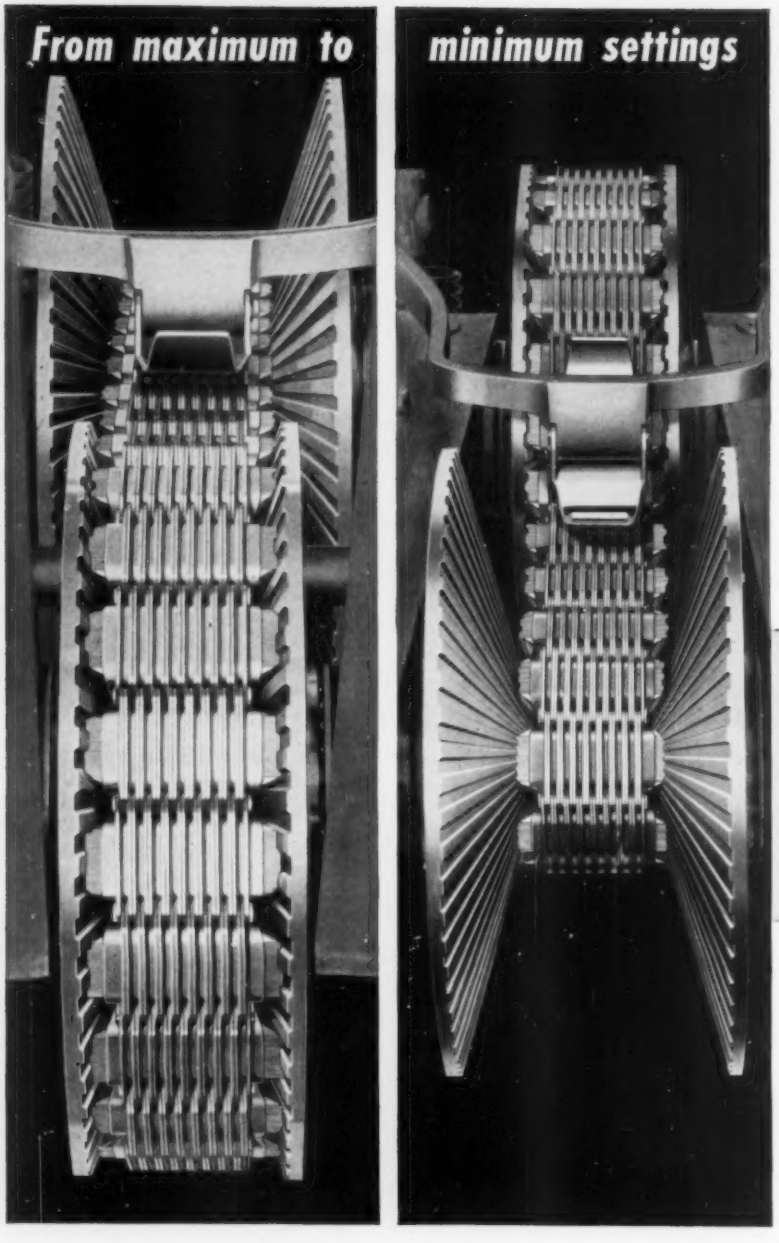
In the S&H instrument (see diagram), the current is supplied by an accumulator cell, and can be adjusted by means of a variable resistance built into the circuit. Since the difference of potential across the strip is proportional to the normal component of the magnetic field, the voltmeter can be calibrated in oersteds and read directly. Range is 50 to 20,000 oersteds; and the instrument carries its own 220-v 50-cycle charger. —ARG



Magnetic field strength is indicated by difference of potential it creates between points *a* and *b* on semiconductor probe of self-contained German instrument.

For positive, accurate speed control

. . . there's nothing like P.I.V.



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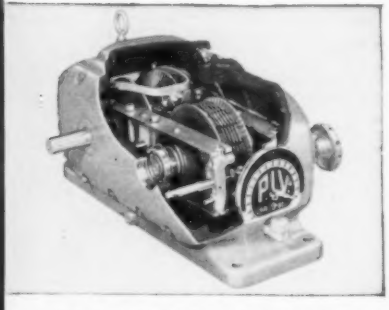


HOW P.I.V. WORKS. Exclusive self-tooth-forming chain of P.I.V. consists of packs of free-sliding steel slats which serve as teeth. Chain grips beveled grooves on pairs of conical wheels located on input and output shafts. Speeds are changed by varying the effective diameters of the wheels, as shown at left.

P.I.V. LINK-BELT
VARIABLE SPEED DRIVE

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,819-A

DEVELOPMENTS TO WATCH...

Washington

US shift to metric system . . .

of measurements will be pushed by Acting-secy. of Commerce Lewis Strauss. He plans to have the National Bureau of Standards start outlining how it can be done.

Strauss made the announcement recently at the spring meeting of the American Physical Society. Stressing the need to shift from the present English measurement system of pounds and inches, Strauss said "There are two compelling economic reasons for making the change. Our country is engaged in a broad technical assistance program to aid other nations in taking advantage of technology and raising their living standards.

"Our experts are finding considerable difficulty in dealing with systems foreign to their own. Many other nations are having difficulty with our instruments because they are labeled in the archaic English system."

Strauss made it clear that he wants industry to help work out a transitional program. But, he stated, "every year we defer the commencement of a program" the shift is more difficult.

Scientists and engineers have won a battle . . .

with the military. Traditionally, the burden of proof has been placed on technical people to show that anything new will work.

Now, the military has thrown open the door and wants to see all new projects that cannot be proved unworkable.

The Department of Defense recently let $1.5-million in contracts to some 12 companies to explore all approaches to anti-missile defense. Dubbed project GLIPAR—guide line identification program for anti-missile research—the rules laid down to the 12 companies are to explore all proposals for anti-missile defense that could be developed over the next 20 years.

And, only those proposals that are proved "theoretically impossible" are to be rejected. Idea behind the move is to cut scientists and engineers away from strictly traditional thinking and positive proof and let them work on "imaginative and bold approaches" to missile defense.

Although the missile age has forced the immediate break with "positive proof" thinking, trend may spread to other fields and make it easier for new scientific proposals to get attention.

Congress seems sure to vote . . .

a short-term extension of the controversial Renegotiation Act; probably for another two years. Congress is reluctant to slap a permanent extension on the act although such a move is being plugged hard by Rep. Carl Vinson (D-Ga.) powerful chairman of the House Armed Services Committee.

Vinson calls the measure "the only protection the Government has against excessive profits" when 92% of defense contracts are negotiated on a cost-plus basis.

Industry has vigorously opposed the Renegotiation Act, but, since an outright killing of the measure is ruled out, it is willing to go along with the short-term extension with certain changes.

Prime target for industry is to get better guide lines spelled out for "excess profits." It wants Congress to write into the law specific language that will give industry real rewards for efficiency, allowing for appeals to the U. S. Court of Appeals when arguments arise.

Industry spokesmen told the House Ways and Means Committee recently that the present renegotiation board is not allowing rewards for efficiency, but rather sets a pre-determined profit rate.

Defense contractors are currently appealing $82-million worth of profits the board has ordered returned to the government. Seven aircraft companies account for $72-million of that amount.

The world's biggest radio telescope . . .

with an optical range of 38 billion light years is under construction by the Navy at Sugar Grove, West Virginia. It will be 19 times more powerful than Palomar Observatory in California.

Although the Navy has kept a tight lid on details about the giant $60-million structure since it was first announced last summer, reports are that the radar dish will be 450 ft wide, over 500 ft high.

The facility will be used to conduct research on a new means of radio communication that will "bounce" radio signals off the moon and man-made satellites. Navy won't say what military uses the radio telescope will serve. Completion of the project is slated for 1962.

All the earth's a pear

The earth isn't round, and it isn't a flattened apple. It's pear-shaped, say NASA researchers. Calculations, based on aberrations in the orbit of the Vanguard I satellite, indicate that the mass of the earth is slightly greater below the equator than above it, so the earth must bulge slightly at the bottom, rather like the squat-shaped Anjou pear.

Importance of the new calculations is they point up variations in the earth's gravitational field. They also indicate that stresses within the earth may be greater than previously assumed, and that the interior of the earth may have greater mechanical strength than has been supposed. Another possibility is that there are large-scale convection currents in the earth's mantle which are responsible for the observed effects.

Further studies are planned with data from other satellites.

New light on corrosion-stoppers

How do corrosion-inhibitors work? Two Pennsylvania U scientists, Erik Blomgren and J. O'M. Bockris have devised a series of tests, using mercury as the base metal, to find out. As they note, knowledge of the mechanism involved in corrosion inhibition is still extremely limited. The prevailing theory is that inhibitor compounds are adsorbed on metal surfaces and that the degree of protection is a function of the degree of coverage.

The mercury tests show:

- Corrosion-inhibiting compounds are adsorbed primarily as ions, which are positioned flat on the surface of the metal.
- Adsorption increases with increasing molecular weight, that is, parallel to the effectiveness of the compounds as corrosion inhibitors.
- Surface coverage increases with concentration, in close parallelism to the corrosion-inhibiting effect reaching 100% coverage and inhibition at 0.01-0.10 mole/liter.

The adsorbed ions also help to repel hydrogen from the metal surface. This, they say, "undoubtedly plays a considerable role in corrosion inhibition."

Blomgren and Bockris plan to describe their research technique and its possible applications in screening corrosion-inhibiting compounds, at the Midyear Meeting of the American Petroleum Institute's Division of Refining in New York on May 27.

Atom power from active pebbles

Can uranium fuel in the form of hard, round, ceramic pebbles help cut the cost of nuclear power? Sanderson & Porter engineers think so, and have done a good deal of preliminary engineering on a gas-cooled, graphite-moderated pebble-bed system in which the fuel is in the form of graphite balls, blended or impregnated with uranium oxide or a mixture of uranium and thorium.

Interest in such a system is based on the belief that, like other fluidized-particle systems, it could combine the chemical and physical advantages of solids with the ease of handling of liquids. Engineering problems are similar too—though the nuclear application introduces a few questions:

- Would the pebbles tend to weld together under influence of heat and nuclear radiation so the bed could not be discharged?
- Could the system accommodate thermal expansion of the balls without cracking the container?
- Could the balls stand the impact of handling in loading and unloading?

Tests thus far are encouraging.

It takes about 50,000-psi pressure and a temperature above 5000 F to weld graphite, which would be the major constituent of each ball. The studies of randomly packed spheres indicate the packing fraction to be only 61%, while the theoretical limit is 84%. The difference should be sufficient to allow for the expected thermal expansion. Finally, impact studies indicate the balls would be fully able to take the stresses involved.

While not all nuclear engineers are as excited about the economic possibilities of the pebble bed reactor as are S&P engineers, the system itself is interesting enough to rate close attention. Background information is available in a printed report prepared for presentation at the American Power Conference. —ARG

Fume sleuth

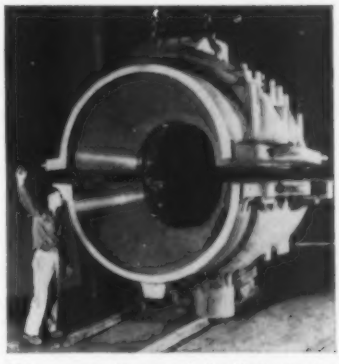
Gas detector kit, developed by Union Industrial Equipment, consists of a hand pump and sets of silica-gel detector tubes, each designed for a specific toxic material (among them: acetylene, ammonia, benzene, carbon monoxide, nickel carbonyl). Air is drawn at a fixed rate through tube, causing a color change or stain-marking that indicates concentration. Kit, with 20 tubes, is $80. Tube sets alone, $10 each.

Design assistance from Blaw-Knox can cut unnecessary weight, improve the service life of your product

One of the ways in which the skill of experienced Blaw-Knox steel foundrymen can be first applied to your product is in the construction of scale models of the finished steel casting. Coming at the preliminary design stage, scale models permit intensive study of ways of improving quality, eliminating weight, and minimizing machining. This design study, coming before master patterns are made, is conducted to uncover ways in which Blaw-Knox can add to the value of your product or reduce its cost.

This practical design analysis, a feature of Blaw-Knox Steel Casting Service, is of invaluable assistance to designers and manufacturers. And because Blaw-Knox, itself, is one of the world's leading manufacturers of rolling mills and industrial machines, its steel foundrymen, from patternmaker to shipper, keep end-use requirements in mind every step of the way.

If you are a designer or manufacturer of a product using cast steel components, ranging from 50 pounds to 300,000 pounds, Blaw-Knox would like to send you a copy of our brochure which details the complete Blaw-Knox Steel Casting Service. Write to the Foundry and Mill Machinery Division, 300 Sixth Avenue, Pittsburgh 22, Pennsylvania.



This upper and lower cylinder blade ring for a steam turbine was cast and machined by Blaw-Knox. Weight—55,000 pounds per half.

BLAW-KNOX **STEEL CASTING SERVICE**

WHAT'S HAPPENING IN... Materials

How cost patterns will change—metals

Labor news dominates the materials picture right now, with users building inventories against threats of strikes as contracts expire in steel, copper and aluminum. But, the experts are betting, the good old laws of economics will take over again by the third quarter. That would mean copper prices, which have been moving up rapidly, will stabilize and probably drop after the contract period. Steel may rise in an amount to compensate for any contract settlement; and aluminum, already in free supply, may do the same, though many observers expect it to steady or perhaps even drop a little.

Until July 1, though, steel in some shapes and sizes will be increasingly hard to get, and copper's price may climb even higher than it is.

The over-all recommendation: design flexibility that will permit rapid shifting of sizes and types as availability changes.

To make it stick, make it smooth

The smoother the surface, the better the bond, two Case Institute scientists report. They've been studying adhesion of polyethylene to metals and find that adhesion in tension is "inversely proportional to the roughness of the surface of the adherend."

For this study, samples were prepared by dry machining, with an attempt being made to get the smoothest possible surface, while recognizing that there would be some residual roughness either in the form of gently rolling hills or sharp, clearly defined peaks. In both cases good adhesion was obtained—by virtue, the Case scientists told a recent American Chemical Society meeting, of adhesion to the smooth sides of the hills—not by locking to the peaks.

They also believe that "air oxidation of the adherends prior to bonding generally smooths the surfaces and increases the adhesion markedly even when the oxide films are only a few hundred angstroms thick."

Their conclusion: In the region of roughness below 25 microinches, strength of adhesion is critically dependent upon the degree of roughness and its precise architecture; much less dependent on the chemical nature of the base metal itself.

Our own glossary V—Names of fibers

From now on, tradenames for fibers will have to take a back seat, if Federal Trade Commission has its way. In labeling, says FTC, generic terms like those below must be used. Trade names may accompany but not overshadow them.

Here, as the fifth installment in our continuing glossary of new and revised terms, are FTC's definitions of several industrially important fibers. In each, the term may be applied to "any manufactured fiber in which the fiber-forming substance is a long chain synthetic polymer having the composition indicated:"

Acrylic: at least 85% by weight of acrylonitrile units.

Nylon: recurring amide groups as an integral part of the polymer chain.

Olefin: at least 85% by weight of ethylene propylene or other olefin.

Polyester: at least 85% by weight of a dihydric alcohol and terephthalic acid.

Saran: at least 80% by weight of vinylidene chloride units.

Rayon is defined as "a manufactured fiber formed from regenerated cellulose with *less than 15%* by weight chemically combined substituents as opposed to:

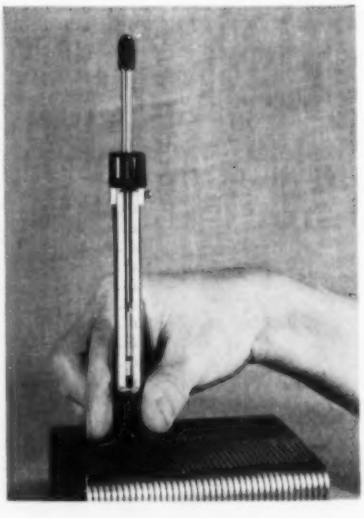
Acetate: "a manufactured fiber in which the fiber-forming substance is cellulose acetate." Where *not less than 95%* by weight of the cellulose is acetylated, the term triacetate may be used.

Other terms included in the complete FTC list: **azlon** (protein), **nytril** (vinyidine dinitrile), **rubber, metallic, alvyne** (vinyl alcohol), **glass, vinyon** (vinyl chloride), **spandex** (polyurethane).

(Note: For reference to earlier installments of our continuing glossary, see *PE*—Aug 25 '58, p 11.)

Tests hardness; will travel

For hardness testing in the field, where portability and accuracy are both important, Precise Products Corp is offering this Sklero unit that weighs only 9 oz complete with wooden carrying case (about 7½ by 2½ by 1 in.), is said to provide readings accurate to within one point, Rockwell C. To use it, says Precise Products, "just place the instrument on the item to be tested, raise the rebound bar, and then release it." The rebound distance shows on the scale, and is locked into position until read. Price, with case: $105. —ARG



Pocket-size hardness tester operator on rebound principle, has hardened-steel ball point mounted on rebound bar.

CIRCLE 57 READER SERVICE CARD→

How Keystone QUALIFIES

as the leading independent producer of POWDER METAL PARTS

(over 150,000,000 of them annually)

We're told, often enough, that "There's a difference in dealing with Keystone."

In looking over some of the reasons-why, it occurs to us that because we were pioneers in powder metallurgy, perhaps we do have a special kind of perspective about our work. Over and beyond the essentials of a sound organization and production facilities to meet your requirements for almost any quantity of parts . . . on time, and at low cost . . . we have qualifications that are inseparable from the Keystone way of doing things.

One of them is *alert interest* in your problems (we learn more that way). Another: *creative approach* to your designs—which keeps us flexible. And one of special importance: *objective evaluation*—if application is unsound, we're frank to say so.

Perhaps we should conclude with *progressiveness*. Facts are, Keystone was first to produce commercially powder metal parts of alloy and stainless steels; first in the field to offer lower-than-commercial tolerance bearings, and first to provide corrosion-resistant finishes on iron powder parts.

For these and other reasons, a great many people turn to Keystone for the powder metal parts their businesses require. It's easily possible that you'd enjoy having us work for you, too. Write, and let's talk it over.

Keystone CARBON COMPANY

ST. MARYS, PA.

POWDERED METAL PARTS DIVISION

How to hang 40 tons of beer from the ceiling

These vessels, called "Dual-Paraboloid" fermentation tanks, are shaped like giant toasters. They're 21 feet long, 13 feet high, and 12½ feet at the widest point. Solar Chicago, Division of U.S. Industries, Inc., makes them from 13-gage Type 304 Stainless Steel sheets that are curved and welded together to form a cornerless interior. 1″ x 4″ ribs are welded around the outside of the tank and all welds are ground to a uniform finish.

Each of the tanks will hold 450 barrels, more than 40 tons, yet the tanks themselves are so light that the entire load will be hung from the ceilings of modern breweries. The formability, weldability and strength of Stainless Steel permitted this unique design. Because the Stainless is so strong, they could use thinner, *lighter* walls.

These tanks weigh 5 tons and they will replace old, square-cornered ones that weighed about *20* tons. Breweries are happy . . . the cornerless, Stainless tanks are easier to keep clean, and because they're off the floor, the plant itself stays cleaner. And because they're Stainless Steel, they will probably never have to be replaced.

USS is a registered trademark

United States Steel Corporation – Pittsburgh
American Steel & Wire – Cleveland
National Tube – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
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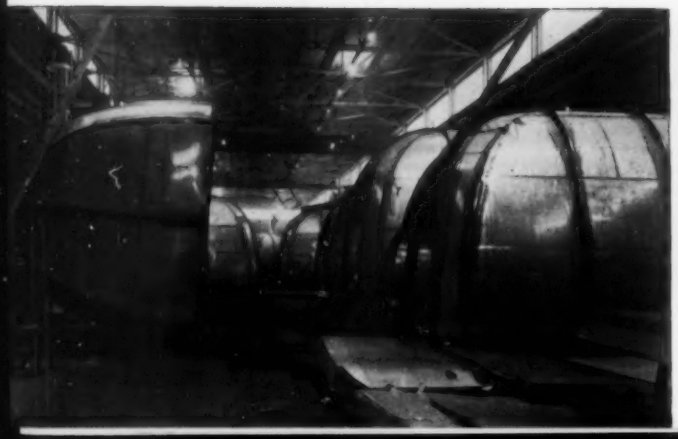
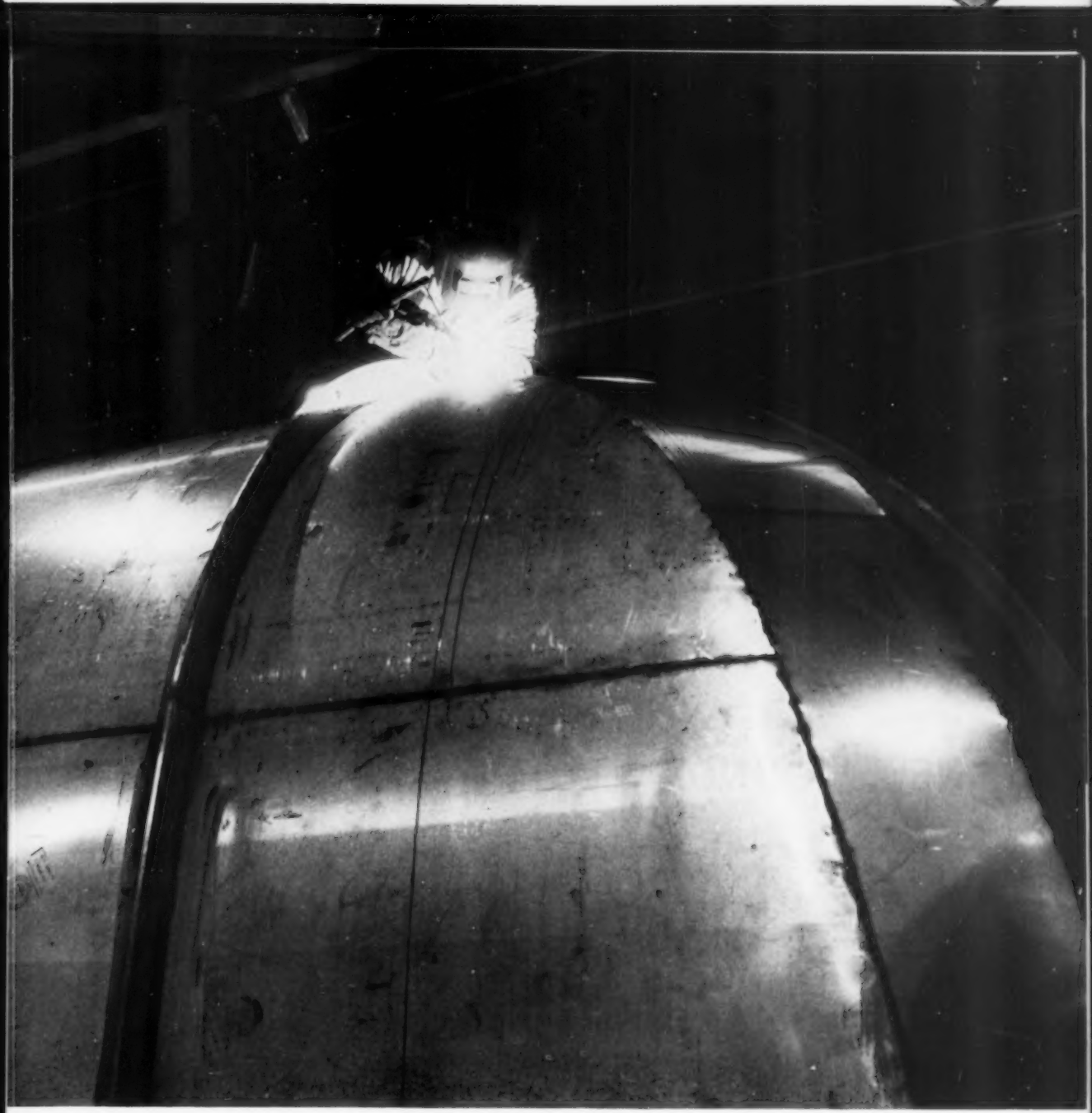
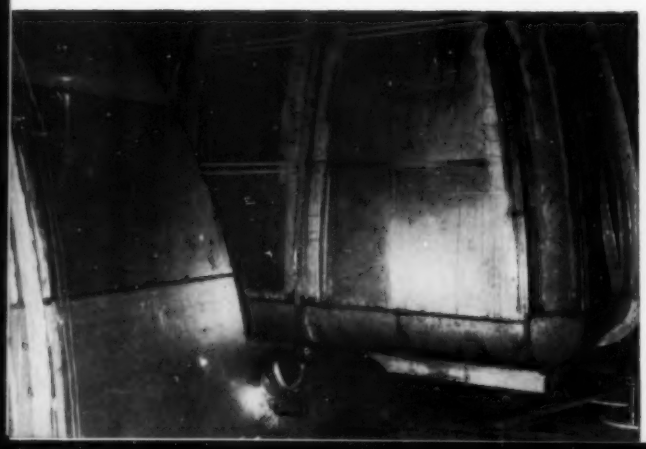
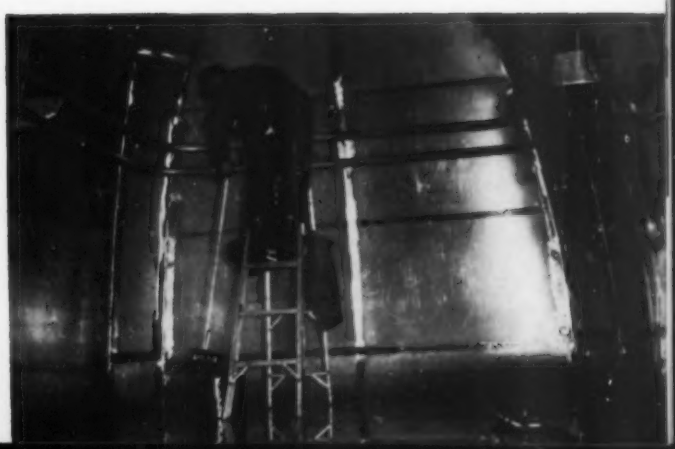








NEW WOUND FIELD MOTORS / VERSATILE

Precision miniature wound field d.c. motors in five basic frame sizes (to 2¼" OD and to 1/10 hp) and in countless variations are now available from Globe Industries. You can design them into many military and other high quality products because they meet such an enormous variety of power and duty requirements. **Examples:**

Split-series units reverse rapidly and simply with a SPDT switch. Series units start with relatively high torque, low current drain. Shunt wound varieties offer means for low current control. Universal motors operate on a.c. or d.c. Globe-designed gear reducers, brakes and clutches can be built into the unit, and Globe can efficiently design and build the motor and accessories into a special motorized device.

If you'd like to look into miniature wound field motors of **any** description, or combine them with other components, ask the largest manufacturer of precision miniature motors first. Request technical Bulletin WF-1. GLOBE INDUSTRIES, INC., 1784 Stanley Avenue, Dayton 4, Ohio.

GLOBE INDUSTRIES, INC. GLOBE

Product Engineering HORIZONS

May 18, 1959

the fabled mugwump

A popular vaudeville monologue years ago concerned the fabled mugwump bird, who sat on a fence with his mug on one side and his wump on the other. It was also reported that he flew backwards, one explanation having it that he did so to cool his tailfeathers, but the more popular one that he didn't give a hoot to see where he was going, but only to see where he'd been.

I am reminded of this periodically by someone who prates of the "American tradition" in this or that, or who decorates in the American tradition. Actually, what is the American tradition? Is it the 18th-century English of our Chippendale, Adam and Sheraton furniture styles? Is it Paul Revere and the Minutemen, Bunker Hill and Lexington Green? Or is it the blended backgrounds of the much higher percentages of Americans who came from other countries than England—and more recently? Should there be a tradition at all?

This question becomes most important when one is banned from the use of certain furniture in a so-called living room because it is a "genuine antique" or a "family heirloom." It is, in as many cases as not, a rickety, tired old piece with a value artificially inflated by age, source or sentiment. Even a superficial examination will in many cases establish the rather obvious fact that it was done "in the style of" —in other words, it is just an ancient copy. Or it may be an authentic "master," but done at an off-period or on an off-day. Or it may be the product of one of the several "masters" who designed, but did not make, their furniture.

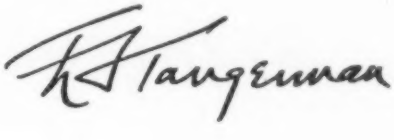
All of which suggests that a great deal of the American heritage is a commercial overtone based on the traditional American habit of sticking the sucker.

Some years ago, a traditionalist said, rather deprecatingly, to my friend Albert Wood, a furniture maker of the present dav: "How does your furniture compare with traditional pieces?" Said Mr. Wood: "Ours is better. It is designed by an architect, so it is inherently strong. We are craftsmen, so it is well made, of solid woods, with the finest dowels and modern adhesives. And, as designers, we're as competent as the old masters were. The real question is not whether the furniture is good, but whether you like it."

As a whittler (at least the word and most of the subjects are traditional American) and occasional woodcarver, I've been interested in our heritage in design for years. Thus it is with a great deal of interest that I've heard the opinions of a very representative group of present-day designers and engineers about the American heritage in design. We are honored that the panel on succeeding pages has consented to record these opinions, and have quoted each in some detail, foregoing for the moment our traditional habit of treating subjects with modern brevity.

You'll find that these distinguished gentlemen are not traditionalists, that they are influenced, but not awed, by tradition, that they look forward as well as around and behind them. They wear no blinders, are not mugwumps. *They learn from yesterday, but aren't hidebound by it.* They are names you know.

And these are the minds that are strongly influencing progressive design in all fields. They are leaving their mark on industrial design, are helping to make it something more than whittled-out functionalism. It is with a great deal of pride that we blend, for this issue, two of our newer and unique departments, "Trends in Appearance Design" and "Points of View," in presenting ten opinions on the American heritage in design.



Every one a "special" fastener

You're looking at "specials"—steel fasteners made to meet a particular need. They are representative of the hundreds of types of specialties which we design and manufacture at our plant at Lebanon, Pa.

Our engineering staff has tackled just about every fastener problem you could imagine. Frequently they come up with suggested design changes resulting in substantial savings for the user.

As for variety of fasteners, the sky is the limit. Long, short, heavy or light. Headed, threaded, bent, or upset.

If you think a special might do a better job than the standard bolt you are now using, let us go to work on it. We'll give it our full attention, then offer recommendations. But if we find that a standard bolt is the answer, we'll gladly tell you so.

Fair enough? Then all you need do is get in touch with the nearest Bethlehem sales office. We'll have an experienced representative call at your convenience.

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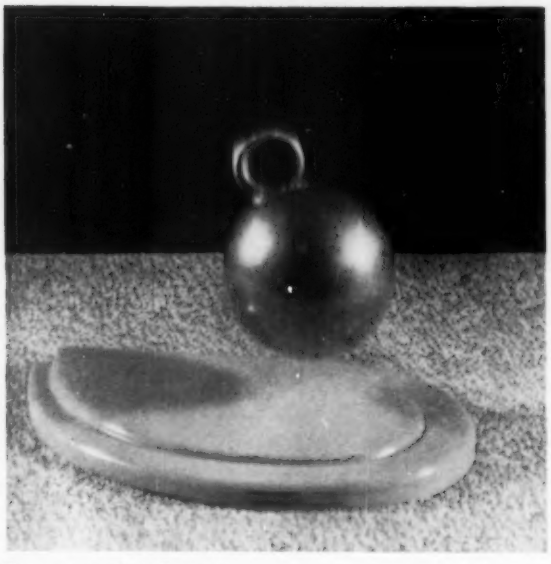
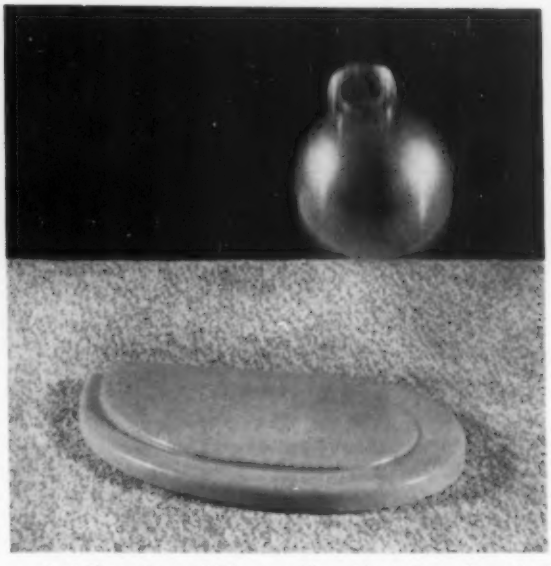
Creep-resistant Plastic Costs Less Than Nylon





Bounce and re-bounce . . . of this 10-lb steel ball demonstrates impact resistance of Kralastic MM, US Rubber's new, nylon-like, rubber-plastic polymer. Ball is dropped from height of 3 ft, left, onto the test piece, a side panel of Pitney-Bowes folding machine. Next photo shows ball on the rebound, having failed to damage the panel. High impact resistance of plastic is one reason for its competitive position with nylon.

NAUGATUCK, CONN—Key feature of a new nylon-like rubber-plastic blend—acrylonitrile-styrene-butadiene—(see *PE*—May 4, p 11) is its low cost 50 cents per lb vs about $1.35 per lb for nylon. The new polymer, created by US Rubber Co, is already off to a fast start in the latest Pitney-Bowes high speed folding machine. Latest data coming from USR concerning ASB's properties are an eye-opener; creep-resistance is excellent at temperatures to 160 F, equilibrium moisture absorption is given as 0.35%, and elastic modulus is high—450,000 psi. This combination of properties, plus a high-stress, heat distortion temperature of 200 F and an impact resistance of about 1.5 ft-lb/in., promises some stiff competition for DuPont's (not yet available in large quantity) Delrin acetal resin. In fact, USR is hoping to steal a march on Delrin by offering its new polymer, now designated Kralastic MM, for sale before summer. Reports are that the company is also thoughtfully eyeing the growing market for polypropylene as a possible competitive area for its new low-cost polymer. For a detailed report on its physical and mechanical properties, as well as other information, see the coming June 8th issue. **—Ford Park**

European Train Designs Leave US Behind

NEW YORK—European railroads have made enormous technical strides in the past decade through well-coordinated research programs and enthusiasm for new ideas and developments. Locomotive designs in particular are well advanced over US counterparts, in part because design groups are separated from maintenance and everyday operating problems and because the railroads themselves lay great emphasis on R & D.

These observations on the technical status of European railroads has been elaborated by Paul V. Garin, manager of research and development for the Southern Pacific Railroad on the basis of a two month study he made last fall. His report, which urges a greater exchange of ideas between US and European railroads, has been released by the American Society of Mechanical Engineers.

Among technical developments that were especially impressive, Mr. Garin listed an anti-slip brake on the Swiss Federal Railways. With this brake, the roads eliminate need for sanding rails to get sufficient traction to haul loads up steep grades. In this country, sanding causes severe rail wear.

In Swiss locomotives equipped with the brakes, power is supplied from a 15,000 volt overhead transmission line to six driving axles each equipped with an ac traction motor. These motors are connected in parallel—in contrast to US where they are normally connected in series—and the locomotive develops 6000 PS (European hp, which is equivalent to 0.986 US hp).

The engineer is provided with a

control wheel having 27 controller positions and 15 electric brake positions, and a voltmeter and six ammeters to show current flowing through each motor. A drop in current indicates that a wheel is slipping. When such a drop occurs, the engineer depresses a button which operates normal brake rigging and shoes on the locomotive for duration of time the button is depressed. Braking pressure of 15 psi is achieved. Because the motors are linked in parallel, current continues to flow to non-spinning motors when current is reduced at the spinning wheel. Hence, driving wheels retain adhesion and aid the spinning wheel at critical periods.

The Swiss roads have also embedded electrical wires in windshields for heating glass and defrosting when necessary. Further, on downgrades the traction motors act as generators for dynamic braking and feed current back to the overhead wire, instead of dissipating it as heat into grids. In this way, the Swiss regain use of 50% to 70% of such current.

In France, the Societe Nationale des Chemins de Fer has a well organized research organization of about 150 persons, Garin observes. Among projects of this group, is research leading to complete automation of the railroad. In 1955, SNCF tested a driverless train that operated at 75 mph, slowed down and stopped at an agreed point—all on instruction from a radio at a substation. A few years later the group tested a driverless diesel locomotive for switching and sorting trains in the classification yard, on instruction from the radio in the control tower. Additionally, the SCNF research unit has developed an automatic signal box that controls switches and signals for a 25-mi section of line. The signal box records and carries out instructions for successive train movements.

The German Federal Railways have a research lab in Munich with a staff of 800 devoted to diesel engine R & D and other technical projects. Mr. Garin noted that German diesels are now equipped with a steam heating generator and an automatic control that prevents engines from starting until temperature of water has reached 160 F. This regulator prevents cold starting damage to engines. He also observed an "interesting" technique for dismounting wheels from axles. With this technique, a passage is drilled at the wheel center through the hub wall to the axle fit. This hole accommodates a high pressure fitting and wheel is removed by applying fluid pressure through the fitting against the wheel seat.

A high degree of technical cooperation between the various railroads of Europe is effected through the Office for Research and Experiments of the International Union of Railways in Utrecht, The Netherlands. Created in 1949, the ORE coordinates technical experiments among the various railroads. Projects are assigned to roads based on their equipment and facilities for handling. ■

PhotoStress Extended to Direct Reading

PHOENIXVILLE, PENNA—Column or bolt alignment, stress-strain curves, torque values, and pressures are a few of the applications possible using the PhotoStress Optical Transducer developed by Tatnall Measuring Systems Co., a subsidiary of The Budd Co.

The load cell can be directly read and is calibrated for the application. The sensing element is ¾ in. or larger, is stable for all temperatures between −100 and +100F. For temperatures above 100F to 400F, temperature correction is required. Fringe position read against calibrated scales give direct values of load.

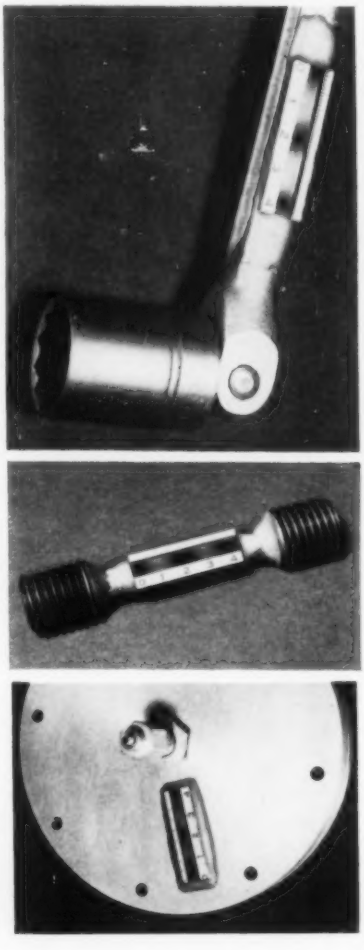
PhotoStress (see *PE*, Mar 2, *p* 43, Sep '56, *p* 167) is based on a double-refracting plastic showing a color strain pattern when viewed under polarized light. The Optical Transducer includes a polarized sheet, hence position of fringes can be viewed under ordinary light without external instrumentation.

Device can be used on any piece of equipment where stress is critical or as a measuring device for pressures, loads, torques, others. This includes, for example, bolts or columns on test equipment, hoists or derricks, shafts, machine tools, automotive or aircraft structures, and others. ■

NSPE Seeks Fee Hike for Federal Consulting

WASHINGTON—A maximum per diem rate of $100 for temporary consultants engaged by the federal government has been urged by the National Society of Professional Engineers in recommendations made to Congressional Appropriations Committee chairman.

The National Society points out that consulting engineers have stated that current maximum per diem rates of $50 or even $75, allowed by several federal agencies, are insufficient for the economically feasible performance of consulting engineering services due to existing high overhead expenses. ■



Direct stress readings . . .
on torque wrench, stress-strain sample, and pressure system. Torque applied to the socket is transferred as a bending force to the wrench handle causing a movement of the fringe giving direct torque readings in in.-lb. Extensiometer application determines stress-strain curve when tension is applied and also indicates misalignment, if present. As a pressure cell, device is used to read pressures in fluid systems.

Systems package concept . . . finds application in the air, on the ground and through waterways to give most efficient maintenance. In Convair 880, below, entire assemblies can be removed and replaced; i.e. Freon condensers in the air-conditioning system, electronics, hydraulics and the engines and pods. Pods of the 880 are equipped with quick-disconnect clamps, electrical connections and ducts so that engine is quickly removable. Above Convair is shown Chrysler-built Army truck; it has an 8-wheel drive, each wheel independently suspended with torsion bars. Made of aluminum, the truck traverses rugged terrain, floats across lakes, can be parachuted from aircraft. Army's new Mark II Landing Craft Retriever, above right, is self-propelled, rubber-tired, gantry crane equipped with lifting hooks and salvage pumps for retrieval of disabled or beached landing craft. Vehicle, weighing 70 tons, is sectionalized in 8 compartments to facilitate assembly and maintenance.

Soviets Declare Output Gains

WASHINGTON—The Central Statistical Administration of the USSR has issued its report of production for the first quarter 1959. The Soviets view the results as satisfactory. Their report states in part:

"Mention should be made of the successes of the key branches of industry upon which the growth of the entire Soviet economy depends; they showed a considerable growth in production as compared with the first quarter of last year. Thus, in the period under comparison, this growth amounted to nine per cent for iron-and-steel and nonferrous metals, 8% for fuel and power, 13% for machine building and metal working, 11% for chemicals and rubber goods, and 25% for building materials. The increase in the light and food industries is also very noticeable—7 and 13% respectively."

The following tables lists production of certain key products along with US production over the same period.

PRODUCTION, 1ST QUARTER 1959	USSR	US
Pig Iron (million tons)	10.5	20.0
Steel (million tons)	14.5	30.5
Steel pipe & tubing (million tons)	1.3	2.0 (est.)
Electric power (billion KWH)	56.8	166.0 (est.)
Coal (million tons)	126.0	108.0
Sulphuric acid (million tons)	1.3	4.4 (est.)
Automobiles (thousand units)	120.0	1899.0
Radio & TV (milion units	1.3	5.0
Refrigerators, household (thousand units)	107.0	800.0 (est.)
Artificial & synthetic fibers (thousand tons)	45.0	218.0

■

New Structural Fasteners Save 33% in Weight

PHILADELPHIA—A new family of high-strength structural aircraft fasteners, companion nuts and bolts, having 220,000 psi muscles in 180,000 psi bodies has been designed by Standard Pressed Steel Co. The 33% lighter-weight threaded joints are a re-design of the firm's earlier 220,000-psi series for specific application in steel and other high-strength structural members.

The new threaded joints can be substituted, size for size, for existing fasteners. Bolts have substantially smaller external wrenching heads, eliminating danger of indentation into fastened material under load. ■

British Say Sky's the Limit for National R & D

LONDON—Britain's Dept of Scientific and Industrial Research says it is prepared to underwrite industrial projects for the next 5 years, "whatever the scale," as long as such projects benefit the nation.

The Dept's research council reported that too many valuable ideas in both small and large companies were going to waste because of a lack of finances. The Dept expects to spend $171 million during 1959-64 as compared to $101 million in the previous 5 years. ■

Frankly,

we're in the dark . . .

Since we started making glass spheres in 1914, they've been used primarily for reflective paints. You see them in use in highway signs and in the road stripes that glow in the beam of your headlight. Now, with increased capacity, we are looking for new, different uses.

Can you use glass spheres, absolutely uniform in size in quality, in diameters available from .040" to .0025". They possess unusual compressive strength, combined with heat resistance, and electrical insulating properties.

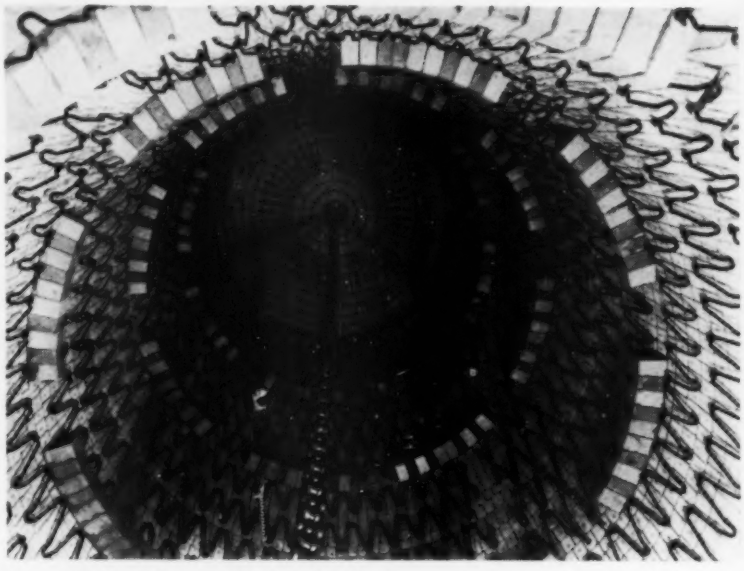
They are the most inexpensive spherical objects to our knowledge. We can even make them moisture resistant.

Do any of their properties suggest a use to you? Samples and all the data we have are yours on request.

POTTERS BROS. INC.

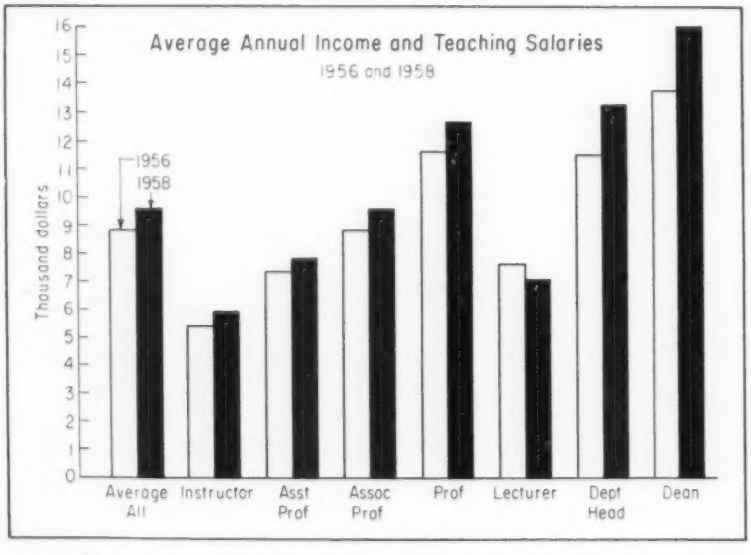
Carlstadt, N. J.

THE ENGINEERING WEEK



Temperatures from 250 F to 2050 F . . . .
are created in this furnace for atmosphere hardening of rocket motor cases and aircraft components at Lindberg Steel Treating Company's Melrose Park plant near Chicago. The furnace is lined with Armstrong A-25 insulating fire bricks—a material that was chosen, company source say, because of its high strength and insulating efficiency. (These bricks have modulus of rupture of 110 psi, compressive strength of 225 psi and Pyrometer Cone Equivalent of 29.) Electrical heating elements are mounted in five tiers to provide five temperature control zones. The furnace, which rolls on wheels along tracks that straddle a large pit, is bottom loading and bottom quenching and will accommodate structures 80 in. dia and 288 in. long. A 6000-cu-ft-hr endothermic gas generator supplied atmosphere to the furnace.

Engineer Teaching Pay Up 8.3% in 2 Years



NEW YORK—Average professional income of engineering teachers in the US has risen 8.3% since 1956, and basic teaching salaries have risen 13.5%. These income gains were reported by the Engineers Joint Council on the basis of a survey of 5000 engineering teachers—about half the

professional persons in the field.

By nature of their occupations, engineering teachers must do research, hence earn income above their basic salaries. The survey showed that average professional income of engineering teachers was $8862 in 1956; $9598 in 1958. Basic salary increase was $894, but this was partially offset by a decline of 7% in outside income. In contrast to the general pattern, deans and department heads show an increase in outside as well as teaching income.

Total income of teachers in public institutions showed greater gains than incomes at privately supported institutions. And, teaching salaries of engineering educators increase with age. Geographically, the salaries ranged from a low of $6744 in the South to $8392 in the Pacific region.

This is the second of these surveys sponsored by the EJC. The report was prepared by the Bureau of Business and Economic Research of Northeastern Univ, Boston. ■

Car Capitol News Roundup

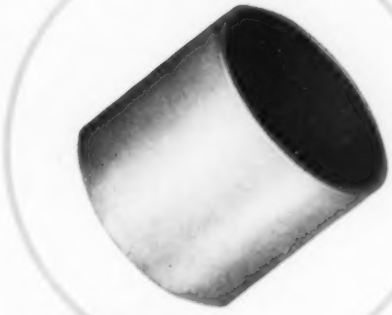
DETROIT—**Renewed emphasis on the engineering** of new retail truck models to fill in the gaps in each maker's line has resulted from 34% sales increase over last year's pace. For example, both Dodge and Ford have recently announced extra-heavy duty diesel models for highway use, although the latter is temporarily restricting sale of this product to export only. GMC, on the other hand, flush with the industry's most complete line of diesel engines, is turning back to gasoline for new product development. **Look for July announcement of two radical engines,** one powerful enough to propel a loaded heavy-duty tractor-trailer combination up grades at passenger car speeds. These gasoline engines are designed, it will be claimed, to give diesel durability without the initial cost penalty.

Crowded engine compartments and overly heavy front ends are causing auto engineers to consider moving accessories such as the power-steering pump, air-conditioning compressor, and starter to the rear undersides of cars where they could be connected to the propeller shaft or differential.

The electric car appears due for a

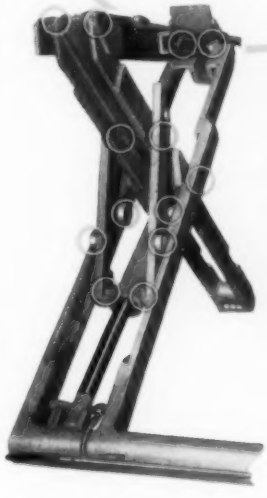
(Continued on page 26)

New Glacier DU Bearings



". . . less than 1/6th the coefficient of friction we had previously achieved at 15,000 psi."

J. E. CLARKE, President
Autoquip Corporation



DU Bearings are installed at vital bearing locations on the Lift made by Autoquip Corp. DU eliminates need for grease fittings, grease grooves, grease guns—and maintenance. Other suggested applications of DU in the auto industry: windshield wipers, steering columns, suspension systems, control rods.

In search of a "permanent" or "dry" bearing for their Porta-Contact hydraulic lift, Autoquip engineers tested new Glacier DU bearing material. To their amazement, DU bearings had less than 1/6th the coefficient of friction of the best material previously tested. Under endurance runs, DU gave equal to three years' service without so much as a squeak. Now, after nearly one year of actual lift operation, not a single bearing problem has arisen!

DU is a patented composite material consisting of a steel-porous-bronze interlayer impregnated with a lead-filled TFE* fluorocarbon resin. It has greatest structural strength, heat conductivity, and thermal stability of any dry bearing . . . withstands temperatures from −328° F to +536° F.

Exhaustive testing of DU has permitted the establishment of curves relating bearing life to various load-speed combinations. Designers can quickly predict DU bearing life by referring to these curves—and other design data—found in Bulletin DU-458. Ask your bearing manufacturer about it, or write to SPECIAL PRODUCTS DEPT., United States Gasket Co., Camden 1, N. J.

United States Gasket

*Teflon, DuPont Trademark
Fluon, I.C.I. Trademark

Plastics Division of GARLOCK

Backlash in Indexing Mechanisms for High Production Machinery

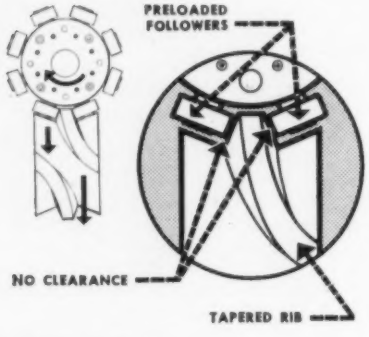
Backlash in indexing results in impact or shock loads that affect the efficiency of a machine and the quality of its product. Most indexing mechanisms have inherent characteristics that cause backlash and poor dynamic conditions and prevent the machine designer from taking full advantage of modern automatic feeds, tooling and methods that contribute so much to production economy.

Of the three principal indexing mechanisms, only one offers zero backlash and years of maintenance-free operation:

FERGUSON DRIVE

Continuously rotating cam includes a tapered rib, along which two preloaded bearing followers roll with no clearance between them and the rib. When the drive is in the rest, or dwell, position a straight portion of the rib locks the followers with *zero backlash* and an indexing accuracy of .001". Wear of the hardened cam is infinitesimal since it is subject to rolling friction only (many cams have been in use for more than 25 years). Followers are rated for a minimum of 8,000 hours precision operation at speeds up to 2,000 indexes a minute. If followers wear after this time, they can be replaced, thus renewing the drive for a like period.

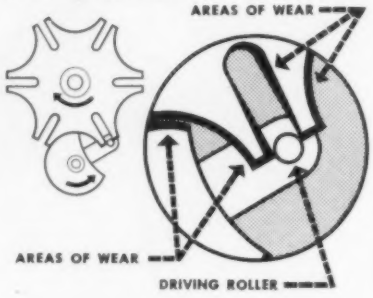
FIG. 1 FERGUSON DRIVE



GENEVA DRIVE

A geneva drive consists of a slotted wheel and a driver with a driving roller. Indexing occurs when the roller crashes into the slot, causing the wheel to move one increment. There must be clearance in the slot to allow passage of the roller. With clearance there must also be backlash. Impact loading, resulting from the inherent backlash, causes the slots to wear quickly and the backlash becomes progressively more severe. Operating speeds must be limited to contain the dynamic forces generated by backlash, even then, genevas require replacement with great frequency and downtime for maintenance is a major problem.

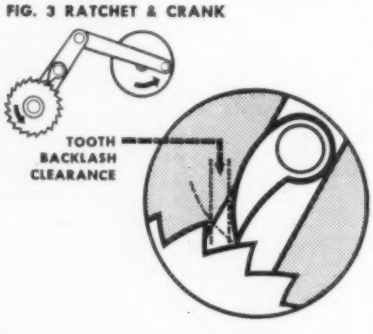
FIG. 2 GENEVA DRIVE



RATCHET & CRANK

Tooth clearance backlash causes the pawl to strike the ratchet teeth with considerable impact when indexing begins and vibratory forces are extreme. After mid stroke, the arm stops the pawl gradually but the wheel must be stopped by frictional braking or by positive means. Friction brakes allow over-travel and inaccuracy of index. They wear quickly and require excess downtime for maintenance. Because positive stopping is instantaneous, impact and rebound action of the wheel is tremendous. Neither method of stopping is satisfactory from the standpoint of low maintenance requirements or controlled dynamic conditions. Sustained high speed production is virtually impossible.

FIG. 3 RATCHET & CRANK



• SEND FOR CATALOG

Zero backlash is only one inherent advantage of the Ferguson Drive. Others are explained in an easy-to-use catalog containing load ratings and dimensions of many standard units, drawings and installation photos. There is a copy for every design engineer . . . Write **FERGUSON MACHINE CORPORATION, 7818 MAPLEWOOD INDUSTRIAL COURT, ST. LOUIS 17, MO.**

(Continued from page 25)

reincarnation of sorts in America. Latest entry is a plastic-bodied, 86-in. wheelbase vehicle planned for the neighborhood shopping trade by Nu-way industries of Lansing, but still furthest ahead is California's Stinson Aircraft Tool & Engineering Corp. Cleveland Electric Vehicle Co. plans to produce electric delivery trucks this year, and is experimenting in the conversion of a Rambler. American Motors recently announced cooperation with Sonotone in the development of a suitable low-cost light-weight battery. If such a battery is found, the two companies plan to go ahead in the joint development of a car which will use a small gasoline engine to keep the battery charged.

DeSoto chief engineer and director of product, A. E. Kimberly, **listed these fundamental unsolved problems** that must eventually be reconciled by the auto industry:

- Adequate traction on slippery surfaces.
- Better method of keeping windshields clean.
- Substitute for lead-based solder to smooth car body surfaces.
- Solder material to serve the same purpose with aluminum or magnesium.
- Reduction of headlamp glare. An entirely new principle is needed to provide effective illumination without glare and without need for adjusting head lamps for oncoming traffic.
- New transparent material with all the desirable characteristics of glass but with greater strength and less weight.
- More acceptable safety belts which the majority of motorists will use at all times.

—Donald MacDonald

Small Generator May Light Entire Cities

WASHINGTON—The lighting of entire cities by small generators in which electrons and ions are shot through a magnetic field, was described by Joseph L. Neuringer, a Republic Aviation Corp. scientist, during a recent meeting of the American Physical Society.

As much as a million watts of electricity could be generated by shooting a stream of plasma (gas broken into

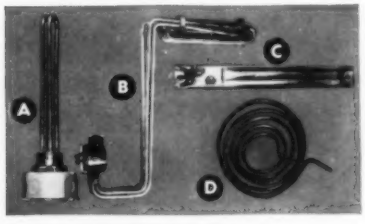
(Continued on page 31)

Liquid Heating Guide

How to choose electric heaters for liquid heating applications

Here is condensed information to help you get the most economical electric heaters for your liquid heating design problem.

Three factors generally determine which type heater should be used for any particular liquid-heating application. They are: the physical characteristics of the container, the nature of the liquid, and the temperature requirements.



General Electric "screw-in" immersion heaters (a) have threaded headers, which make for easy and permanent installation in pipes, tanks and vessels. "Over-the-side" immersion heaters (b) hang in tanks or containers, and besides being portable, they are ideally suited for heating rubber-lined tanks, lead-lined tanks, tanks of wood, slate, and other materials which are not adaptable to heaters with threaded headers.

Because some metals are subject to attack when immersed in certain liquids, G-E heaters are made in a variety of sheath materials so that they can be used for a wide range of liquids. Sheath materials of copper, steel, stainless steel, nickel, nickel-plated copper, nickel-silver, Inconel, Monel, cast iron and lead are all available.

General Electric heaters are ideally suited to heating a wide range of liquids: Water, oil, electroplating baths, cleaning compounds, chemical baths, and other fluids. These liquids can be circulating or non-circulating; in open containers, closed or pressure, vessels, kettles, or steam generators. Heavy viscous liquids, such as pitch, molasses, and asphalt can be heated by using a liquid jacket containing immersion heaters.

Where extremely corrosive liquids are to be heated, it is also often best to use a water jacket around the tank. Immersion heaters may be used for water heating in this type of application. Many times, it is easier to clamp strip heaters (c) or tubular heaters (d) to the side of the tank.

TABLE I—Water, Alkaline or Plating Baths

Amount of Liquid		Degrees F Temperature Rise						
Cubic Feet	Gallons	20	40	60	80	100	120	140
		Kilowatts to Heat in One Hour						
.66	5	0.3	0.5	0.8	1.2	1.6	2	2.7
1.3	10	0.5	1.1	1.6	2.4	3.2	4	5.3
2.0	13	0.8	1.6	2.4	3.6	4.5	5.7	7.2
2.7	20	1.1	2.2	3.2	4.8	6	7.5	9.5
3.3	25	1.3	2.7	4	6	7.5	9.5	12
4.0	30	1.6	3.2	4.8	7	8.8	11	14
4.7	35	1.9	3.7	5.6	8	10	13	16
5.3	40	2	4	6	9	12	15	20
6.0	45	2.4	5	7	11	14	18	23
6.7	50	2.7	5.4	8	12	15	19	24
7.4	55	3	6	9	13	16	20	25
8.0	60	3.3	6.4	9.6	14.5	18	23	29
8.7	65	3.5	7	10	15.5	19.5	25	31
9.4	70	3.7	7.5	11	17	21	26	33
10	75	4	8	12	18	23	29	37
10.7	80	4.3	8.5	13	19	24	30	38
11.4	85	4.5	9	13.5	20	25	31	39
12.0	90	5	10	14.5	22	28	35	44
12.7	95	5	10	15	23	29	37	47
13.4	100	5.5	11	16	24	30	38	48
16.7	125	7	13	20	30	38	48	60
20.0	150	8	16	24	36	45	57	72
23.4	175	9	18	28	42	53	67	85
26.7	200	11	21	32	48	60	75	95
33.7	250	13	27	40	60	75	95	120
40	300	16	32	47	70	88	110	140
46.8	350	19	37	56	83	105	130	165
53.4	400	21	43	64	96	120	150	190
60.1	450	24	48	72	107	135	170	214
66.8	500	27	53	80	120	150	190	240
Maximum Time (hours)		10	10	7	5½	5	4	3½

TABLE II—Use This Table For Oil

Amount of Oil To Be Heated		Degrees F Temperature Rise					
Cubic Feet	Gallons	50	100	200	300	400	500
		Kilowatts to Heat in One Hour					
.5	3.7	.3	.5	1	2	2	3
1	7.4	.5	1	2	3	4	6
2	14.9	1	2	4	6	8	11
3	22.2	2	3	6	9	12	16
4	29.9	2	4	8	12	16	22
5	37.4	2	4	9	15	20	26
10	74.8	5	9	18	29	40	52
15	112.5	7	14	28	44	60	77
20	149.6	9	18	37	58	80	102
25	187.	11	22	46	72	100	127
30	222.5	13	27	56	86	120	151
35	262.	16	31	65	100	139	176
40	299.	18	36	74	115	158	201
45	336.5	20	40	84	129	178	226
50	374.	22	45	93	144	197	252
55	412.	25	49	102	158	217	276
60	449.	27	54	112	172	236	302
65	486.	29	58	121	186	255	326
70	524.	32	62	130	200	275	350
75	562.	34	67	140	215	294	375
Maximum Time (hours)		10	10	8	7	6	5

To figure the amount of heat required for your application:

1. Find the number of gallons or cubic feet of liquid to be heated.

2. Figure needed temperature rise in degrees F. (Subtract initial temperature from needed temperature.)

3. Check either Table I or Table II from the nearest amount of liquid to the desired "temperature rise" in the right-hand column.

4. Add 4% to the figure you now have if there is no insulation on your container or tank.

5. Divide the answer in Step 4 by the number of hours available for initial heat up of the liquid. You now know how many kilowatts of heat are required for your installation.

For complete information on sizes and ratings of General Electric heaters, call your General Electric Apparatus Sales Office or send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

Section F723-26, General Electric Co., Schenectady 5, New York.

Please send GEA-6305, heating water and baths; GEA-6306, heating oil and GEC-1005, catalog of G-E Heaters and Devices.

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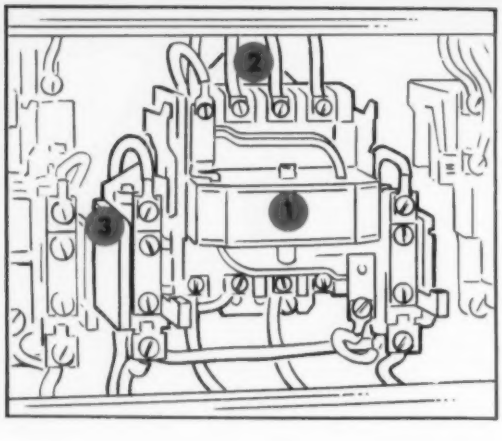
GENERAL ELECTRIC

CIRCLE 63 READER SERVICE CARD

CIRCLE 64 READER SERVICE CARD →

NEW SIZE 2 MAGNETIC STARTER

Now available in G-E 100 Line design



1. **42% SMALLER SIZE.** The new 100-Line General Electric magnetic starters (Size 0 and 1) are only as high as G-E 4- and 6-pole relays. You no longer waste space on your panels.

2. **STRAIGHT-THROUGH WIRING.** All you do is insert your leads into the pressure-type terminals and tighten. They are on the front of the new G-E magnetic starter — easy to reach.

3. **ADJUSTABLE OVERLOADS.** A new finger-tip adjustment of the overload relay trip setting allows easy adjustment between plus or minus 15% of the nominal heater rating.

NEW G-E SIZE 0 AND 1 MAGNETIC STARTERS

Cut cost by reducing panel space and assembly time

BECAUSE THEY'RE 42% SMALLER — FEATURE STRAIGHT-THROUGH WIRING, FRONT CONNECTIONS

These new, radically different 100-Line General Electric magnetic starters have been designed to help you save panel space and assembly time.

SAVE PANEL SPACE. The new starter is 42% smaller — now approximately the same height as G-E 4- and 6-pole relays. When starters and relays are mounted side by side, you no longer waste space below the relays. G.E.'s straight-through wiring and cooler operation mean you need only ½ inch on each side of the new starter. The coil inrush current has been reduced so you can use a 40 volt-amp control transformer. You also have your choice of vertical or horizontal mechanical interlocking on reversing starters. The savings in panel space also help meet the new JIC specifications.

SAVE ASSEMBLY TIME. The new, 50% lighter weight G-E magnetic starter is fast and simple to install and connect. Straight-through wiring means you attach leads to the terminals at the top and bottom of the starter — no more run-a-round wiring to take extra time and space. You mount the starter by simply sliding its key holes over three mounting screws on the panel. This new General Electric magnetic starter will easily cut your assembly time.

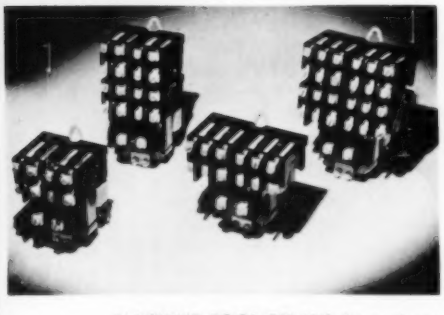
Your customers will enjoy extremely quiet, dependable operation — and appreciate the fast inspection and the 20-second disassembly, made possible by "snap-slide" construction. They'll also like the space savings your smaller, more compact panels provide.

Like more information? Contact your nearby General Electric Apparatus Sales Office, or write to Section 731-15, General Electric Co., Schenectady, N. Y., and ask for bulletin GEA-6611.

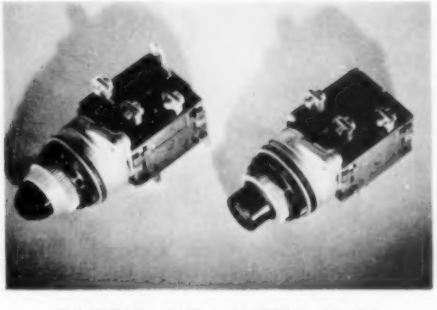
General-Purpose Control Dept., Bloomington, Ill.

Progress Is Our Most Important Product

GENERAL ELECTRIC



MACHINE TOOL RELAYS have front connected terminals, are easy-to-wire from four directions, and are also available in latched-in forms.



OIL-TIGHT PUSH BUTTON UNITS. The new push to test unit checks for burned out bulbs — the new illuminated unit reduces panel space 50%.

STATIC CONTROL components, in easy-to-use plug-in form, provide reliability for critical jobs. Photo shows three steps of encapsulation.

CAMPCO PROGRESS

latest developments in plastic sheet • film • fabrication

New Concept in Luggage

Campco Linear Polyethylene Sheet

Light-weight, rich-looking quality luggage at half the cost of conventional types is now possible with a new Campco Copolymer Linear Polyethylene sheet. The excellent physical properties of this material form into luggage that is almost indestructible in resisting the impact and abrasive wear and tear of baggage handling, extreme cold (to −180°F), moisture, mildew and chemicals.

Its high tensile and flexural strength make applications with complicated draws like forming luggage possible.

Campco Linear Polyethylene lends itself to all conventional forming techniques, machines readily and can be rapidly die-cut to size and shape. Sheets can be bonded with commercial cements or welded with heat and pressure.

Available in smooth or Haircell grain embossed finish, sheet or roll from .020 to ¼" thick. Excellent for automotive interiors, apparatus cases, housings for business machines, housewares, cabinet drawers, duct work and exhaust hoods.

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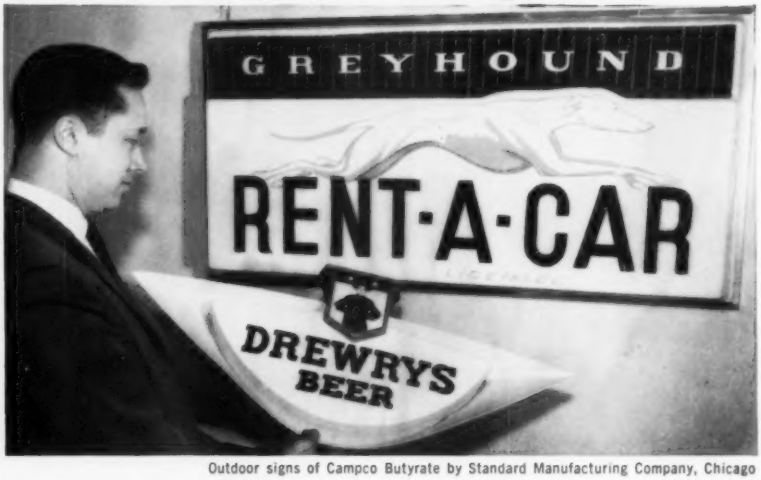
See the latest packaging and display applications of

Polyethylene, Acetate, Butyrate, Styrenes, Polypropylene, Nylon.

Campco Butyrate scores in weather tests, opens new vistas in outdoor signs



Outdoor signs of Campco Butyrate by Standard Manufacturing Company, Chicago

Colorful outdoor plastic signs that can withstand weather hazards without becoming brittle or losing their brilliance are now possible with a special Campco Butyrate sheet. Made from resin supplied by Eastman Chemical Products, Inc., Campco Butyrate is tough, durable, easy to form, and completely weather resistant.

Weather-test results at Arizona checking stations assure the resistance of Campco Butyrate to extremes of sunlight, rain, heat, cold, snow and wind. Moreover, its surface resists dirt build-up and washes clean in rain.

Because Campco Butyrate is strong and resilient even in thin sections, substantial savings can be effected in its application for outdoor signs. A little goes a long way. Its ease of forming opens unlimited design opportunity—imaginative shapes . . . new vistas in outdoor signs.

Campco Butyrate is available in clear crystal or a variety of colors—rolls and sheets in thicknesses .005" to .125" stock or custom size. Clarity ranges from transparent through translucent to opaque.

It's easy to decorate by either lacquer or silk-screening. Attractive combinations of bright trademarks, slogans or other wording against colored or clear background are easy to achieve.

Campco Woodgrain Sheet sells "A'lure"

Handsome counter displays of Campco Woodgrain finish plastic sheet are helping to sell Warner Brothers "A'lure" bras in apparel stores throughout the country. This new Campco sheet looks like solid wood but is light as a feather, and has all the excellent qualities of standard Campco sheet . . . high impact resistance, dimensional stability and outstanding formability. Available in cut-to-size and standard sheets from .040" to .187" thick.

Received Your Campco Personal File? This data-packed reference file on thermo-plastic sheet and film is yours on request—just send name and address on Company letterhead to Campco, 2711 Normandy Avenue, Chicago 35, Illinois.

CAMPCO Sheet and Film, **a Division of Chicago Molded Products Corp.**

(Continued from page 26)

electrons and ions) at speeds three times that of sound through a magnetic field only 3 ft long, and with the magnetic poles 6 in. apart. In effect, electricity would be a direct product, eliminating steam boilers, turbines, other heavy machinery.

Neuringer said also that large-scale plasma generators can be developed within 5 years. A large, steady stream of plasma might be produced chemically or by fusion nuclear reactors, he said.

Small generators already have a direct application in the "magnetic pinch" engine, designed by Republic for space propulsion from which streams of plasma are shot out the rear of the space ship. ■

Advises Sounder R&D Management

SAN FRANCISCO—After completing nearly 50 major technical audits for a wide variety of companies, Arthur D Little Inc, Cambridge, Mass., concludes that US firms frequently make two errors in implementing their research programs:

They (1) fail to make clearly defined plans for the future and to communicate these plans to top technical people; and (2) fail to carry out technical-economic evaluation of new processes or products to help management make sound plans for the future.

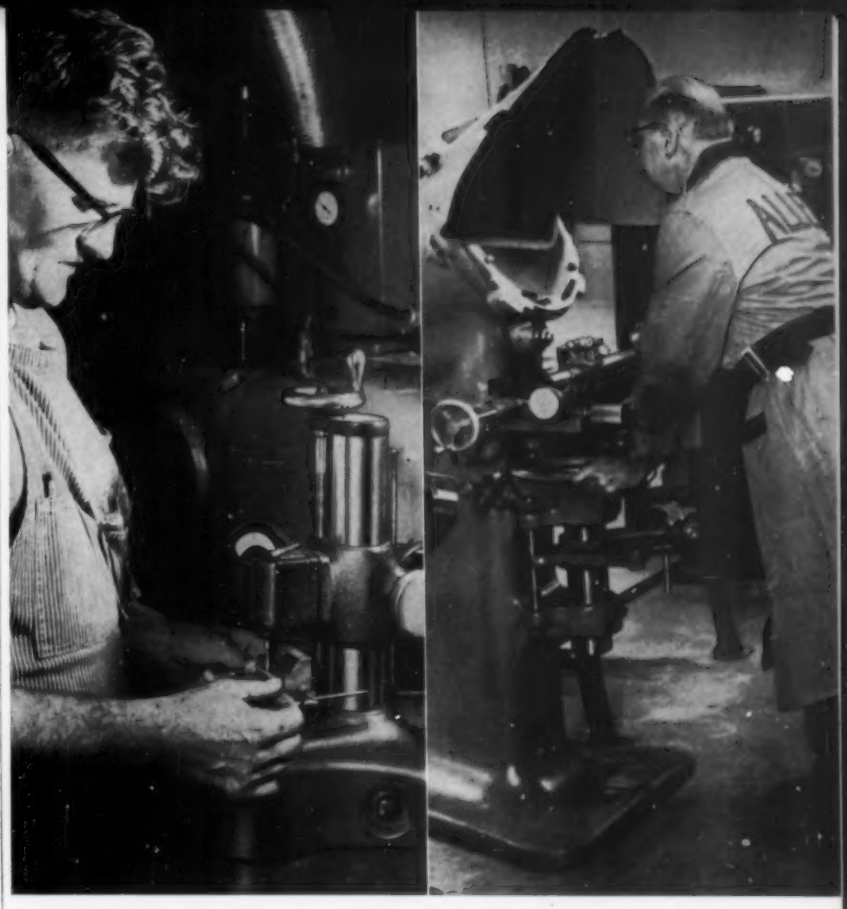
This appraisal was given here by Earl P. Stevenson, chairman of A. D. Little's board, in an address to the MIT Club of Northern California.

The growth of industrial research has been truly phenomenal in the past decade, Mr. Stevenson noted. Overall national expenditures are now expected to exceed $10 billion for the next fiscal year—a billion more than predicted a year ago. And in the decade of the '60s, financial support of R & D will probably rise to $120 billion from $60 billion in the '50s.

But new technological advances from such spending, he added, will depend on availability of top scientific and engineering manpower. "The inventive genius may have yielded in large degree to the research team, but the game is becoming more complex, the plays more baffling . . . and now we have a critical shortage of quarterbacks."

(Continued on page 33)

CIRCLE 66 READER SERVICE CARD



A NEW HIGH IN QUALITY CONTROL MEANS A NEW HIGH

in Quality Fasteners from

ALLEN

Long famous for advanced quality control techniques, Allen has expanded its Quality Control Division in its great new plant. From coil or bar stock right thru to the label on the box, each lot of Allenoy Steel is coded with its own number and checked with the finest equipment available. Furthermore, screws in process are gaged for dimensional accuracy – right at the machines.

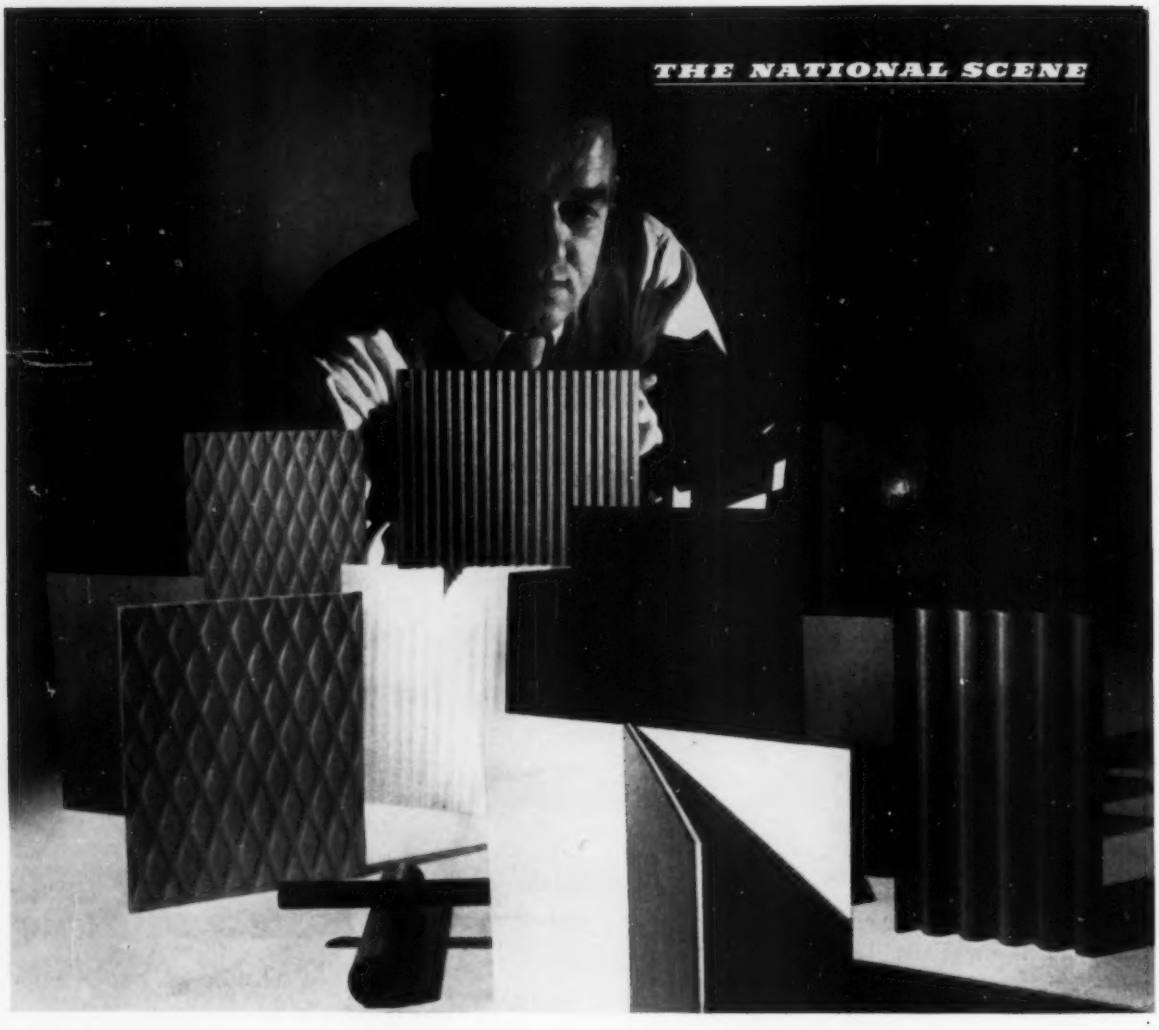
If you want better performance made possible by the latest in manufacturing facilities, techniques and know-how, always insist on genuine *Allen* products.

LEADER POINTS—another Allen exclusive (No. 8 and up) . . . helps speed assemblies.

In Cap Screws, there's no substitute for Allen Quality: 619 *standard* items . . . pressur-formd . . . for greater strength at vital points . . . with Class 3A threads, Class 2A above 1" dia.

Use **FLAT HEADS** for firm fastening with flush surfaces; No. 4 thru ¾" dia., lengths ¼" thru 2" . . . **BUTTON HEADS** for that streamlined look, without countersinking; No. 4 thru ⅝" dia., lengths ¼" thru 2" . . . **STAINLESS STEEL CAP SCREWS** for corrosion and heat resistance, high tensile strength; No. 0 thru ⅝" dia., lengths ¼" thru 3". For complete details, see your local Distributor, or write Allen Manufacturing Company, Hartford 1, Connecticut.

ALLEN HEX-SOCKET SCREWS HEAD



"Here's a boxful of cost-cutting, product-improving ideas for you"

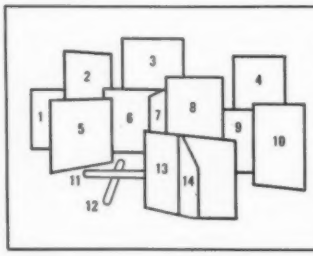
In versatility, performance and cost, Vulcanized Fibre may help crack your next design problem

For proof, look at this National product and its almost unbelievable range of uses. To name a few: delicate surgical instruments; rail joint insulation for railroads; clothes hampers for the home; dense, durable gears and cams; flexible backings for abrasive disks; arc chutes for lightning arrestors; motor insulation; punched tape for data processing machines; formed athletic guard equipment.

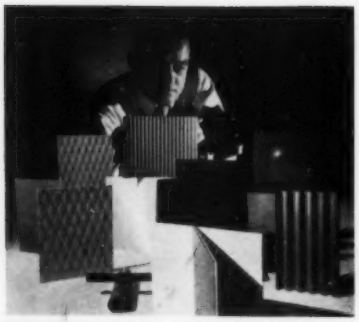
Among engineering materials you'll find National Vulcanized Fibre unique and surprisingly economical. It weighs only half as much as aluminum. It has unsurpassed arc resistance, low thermal conductivity, excellent resilience and high abrasion resistance. It absorbs sudden and repeated shock and impact without failure. And it is available in a fire resistant grade.

After 100 years, users are still finding new things they can do *to* Vulcanized Fibre. It can be machined, polished, painted, embossed, lacquered and combined with other materials, such as laminated plastic, aluminum, wood, rubber, asbestos or copper. It can even be formed or deep drawn into intricate shapes. Available in both standard and special forms and sizes.

Send for our special kit of samples (shown above)—write on your letterhead please—and evaluate the design possibilities personally. Let us know what use you have in mind. We'd like to help. National Vulcanized Fibre Co., Dept. H-5, Wilmington 99, Delaware.



1. "Peerless" Electrical Insulation. **2.** Embossed, vinyl finish. **3.** Corrugated "Peerless" .010. **4.** Fibre and "Mylar." **5.** Cold embossed. **6.** Fibre-Copper, two-sides copper. **7.** Black Commercial. **8.** Fibre-Laminated Plastic, two-sides fibre. **9.** Red Commercial. **10.** Corrugated. **11.** Rod. **12.** Tube. **13.** White. **14.** Fibre Armored Plywood.



CHOOSE FROM THESE MATERIALS...

Vulcanized Fibre: 10 standard grades; many special grades.

PHENOLITE® Laminated Plastic: over 80 standard and modified grades; paper, cotton fabric, nylon, asbestos,. glass fabric, cotton and glass mat bases; phenolic, melamine, polyester, epoxy, "TEFLON" or silicone resins.

PEERLESS Electrical Insulation: coil, strip, corrugated.

Extruded Nylon: 2 grades; rod, strip, pressure tubing, special shapes.

Polyester Glass Mat: 4 standard sheet grades; custom molded shapes.

PHENOLITE Copper-Clad Laminates: 10 standard grades.

Combination Materials: Rubber-PHENOLITE; Rubber-Fibre; Wood-Fibre; Metal-Fibre; Asbestos-Fibre; PEERLESS-PHENOLITE.

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NATIONAL VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE
In Canada:
NATIONAL FIBRE COMPANY OF CANADA, LTD., Toronto 3, Ontario

(*Continued from page 31*)

To correct the manpower limitations, Stevenson advised new methods for using technically trained people—for example, closer cooperation between universities and industry. He also urged companies do more "research on research." His company calls this the technical audit—a detailed analysis of needs, programs, techniques, people, financial support and facilities. ■

Design Air Prop in Circular Shell

BONN—A 4-bladed pusher propeller installed in a cylindrical shell at the rear end of a pear-shaped cabin, highlights design of a business plane being developed at Rhein-Flugzeugbau Works in Krefeld, West Germany.

According to the plane's designer, Hanno Fischer, the tapering inner surface of the shell will increase static thrust of the propeller by at least 25%, and indirectly, will improve lift. Twin flaps located across the horizontal diameter at the rear end of the shell are coupled direct to the tail controls and are operated with these. The extra lift obtained by this flap make-up is sufficient to allow the fully loaded plane to take off from a 500-ft runway.

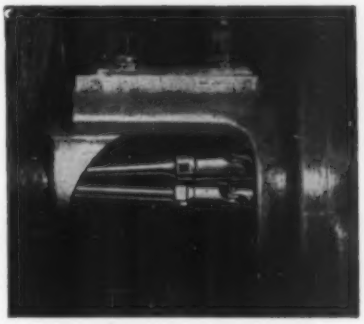
Power to the single 4-bladed propeller is provided by two 245-hp Lycoming engines installed in each of the wings.

Drive from each of the engines is transmitted over two shafts to a bevel-gear differential, or final drive, located just ahead of the propeller boss. The advantage of this layout is that either of the engines can be cut out during flight to conserve fuel and the single engine still running will deliver sufficient power to maintain flight conditions.

Wings on the prototype will be a single metal spar but Rhein-Flugzeugbau are experimenting with reinforced-plastic wings. Providing results are satisfactory, this configuration will, in all probability, be incorporated into the design of the first series produced. At the rear of the cylindrical shell, the welded tubular-steel fuselage funnels out from 15¾ in. dia to 25½ in. to take tail and fin assembly.

The 6-piece craft, designed to sell at about $35,000 will undergo prototype tests, early next year. ■

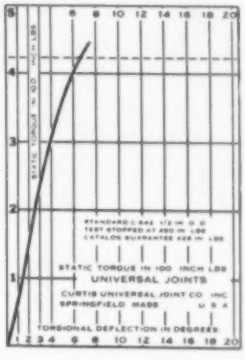
Solving a breakage problem AT CLOSE QUARTERS



The manufacturer of this button-drilling machine had a tough problem: the universal joints on these parallel shafts carried such a torque load there were frequent complaints of breakage . . . yet the close centers prohibited use of a larger joint.

THE SOLUTION was a Curtis Universal Joint of the same size.

Torque Curve ½" Curtis Universal Joint



This is only one of many problems solved by Curtis Joints — size for size the strongest universal joints designed for industry. Selected materials, precision engineering, and over 30 years' experience manufacturing universal joints make them that way.

14 SIZES ALWAYS IN STOCK —
3/8" to 4" O.D. (6" joints on special order)

Not sold through distributors. Write direct for free engineering data and price list.

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As near to you as your telephone

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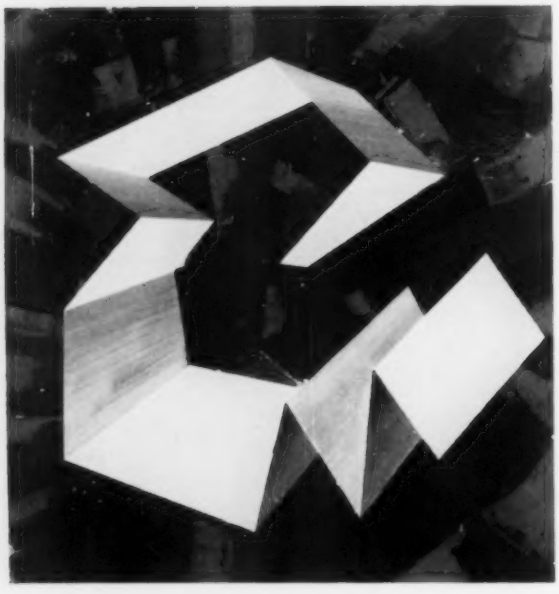
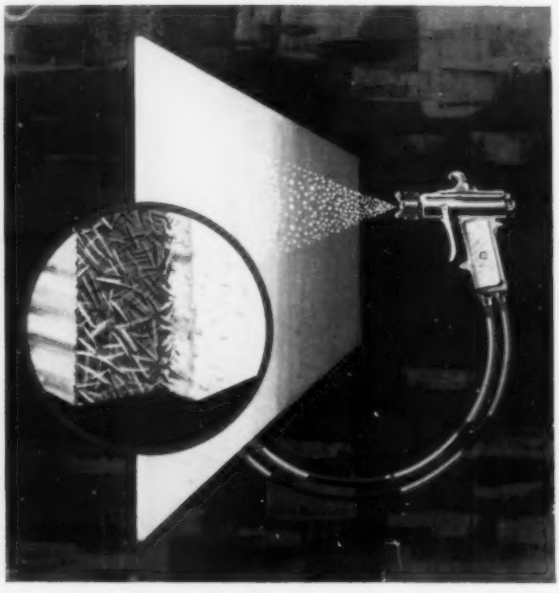
ARMCO STEELS / for better products • lower costs

ARMCO'S SPECIAL COATED COMBAT HEAT AND CORRO

Sheets coated with aluminum or zinc offer design and





Armco ZINCGRIP® Steel

Gives your products the complete protection of a special hot-dip zinc coating that won't flake or peel even in severe forming or drawing operations. Produced by the Armco-developed Sendzimir hot-dip process, ZINCGRIP Steel has been proved by almost a quarter-century of use in a wide range of applications. Its uniform, tightly-adherent zinc coating not only assures over-all protection against rust and corrosion but facilitates production. You can add extra sales value to your products, often at less cost.

Armco ZINCGRIP PAINTGRIP® Steel

This grade of Armco Coated Steel is the same as ZINCGRIP with the addition of a mill-applied surface treatment that gives it *excellent paintability*. Not only can ZINCGRIP PAINTGRIP be painted without any additional treatment, but its special surface prolongs paint life. For parts that require the protection of a zinc coating and must be painted, the properties and uniformly high quality of this paint-preserving Armco Steel create opportunities for product improvement and production savings.

Wherever parts require low cost but durable protection against heat, corrosion, or a combination of both, consider the multiple advantages offered by Armco's Coated Steels. Four grades of hot-dip aluminum-coated or zinc-coated steel enable you to match performance against service requirements at least cost and without compromise.

For more information on these special Armco Steels and how they can be used most effectively in **your** products, just fill out and mail the coupon.

Armco Steel Corporation
2039 Curtis Street, Middletown, Ohio

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New steels are born at Armco

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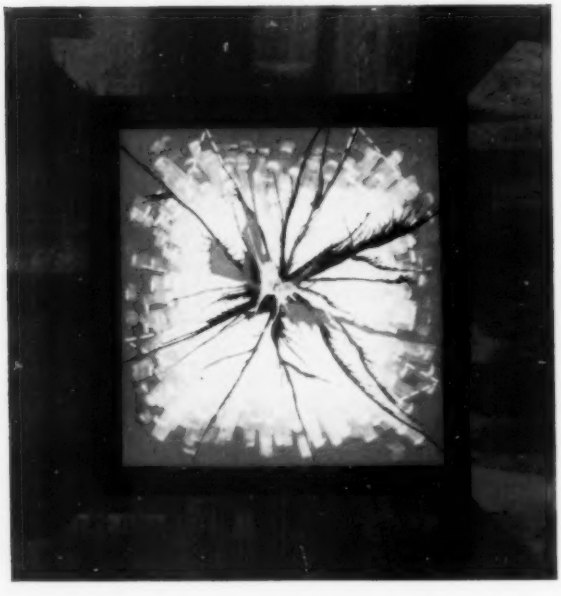
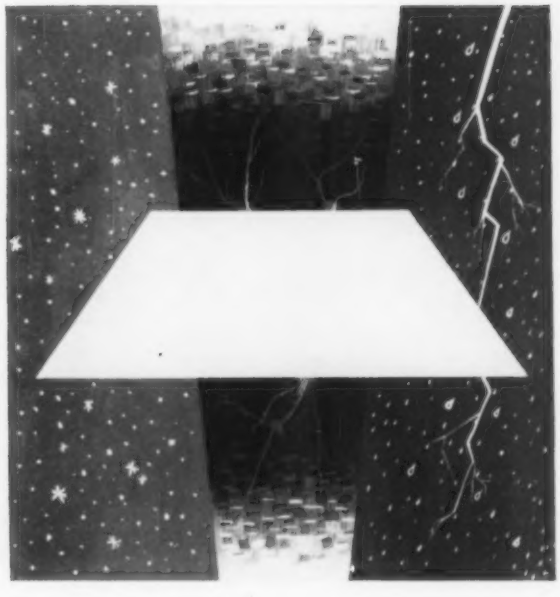
production advantages



Armco ALUMINIZED STEEL Type 1

Combining the surface characteristics of aluminum with the physical and mechanical properties of steel, this special grade has advantages offered by no other metal in its price class. In addition to excellent resistance to a combination of heat and corrosion, it has high heat reflectivity and good fabricating characteristics. Armco ALUMINIZED STEEL Type 1 is unmatched in economical durability for applications such as gas-fired heat exchangers and combustion chambers, auto mufflers, drying ovens and appliance parts.



Armco ALUMINIZED STEEL Type 2

Outstanding property of this grade of Armco Coated Steel is its low cost, lasting protection against atmospheric corrosion. The unique hot-dip aluminum coating offers rust-protection, and the steel base provides adequate strength and rigidity for structural applications. Atmospheric corrosion tests and service demonstrate that the coating on Type 2 ALUMINIZED STEEL outlasts unpainted galvanized coatings at least 3 to 1. For products exposed to the atmosphere, it assures dependable durability at minimum cost.

ARMCO STEEL

Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation • Southwest Steel Products

does AMERICA have a

Designers, engineers and marketers debate the factors that should determine the appearance and the engineering of American manufactured products. All talk of the presence – or lack – of traditions of good design in America's history and culture. How strongly people feel about this was indicated by "Eight Design Authorities Evaluate '59 Cars" (PE – Dec 1 '58 pp), and by

• *Henry Dreyfuss – Industrial Designer; past president, American Society of Industrial Designers; his work includes everything from fountain pens to ocean liners, including 80% of American telephones*

Yes, I do think we have a heritage of good design, a tradition designers can draw strength from. American design, like many other things in American culture, has its roots among the people who first came here from Europe. It developed among people involved in a day-to-day struggle for survival. The design ideal of these hard-working, practical people – although no one talked about design I'm sure – consisted of simplicity, toughness, efficiency and good workmanship. There was no time for frills; decoration seemed a pointless luxury among people who barely had the necessities.

Later on somebody called this "functionalism," but obviously it didn't start as an esthetic concept at all. If a tool, farming implement or other humble object functioned properly, the early American farmer or artisan was satisfied. He probably wasn't conscious of any esthetic satisfaction from these well-made objects. But in some indefinable way, the clean lines, dramatic shapes, powerful forms which had been unwittingly created were enjoyed by these men and women, for whom the words "design" and "taste" barely existed.

The best American designs have the solid, powerful, tidy, everything-in-place, nothing-superfluous quality of an old sailing ship. I like the term "shipshape."

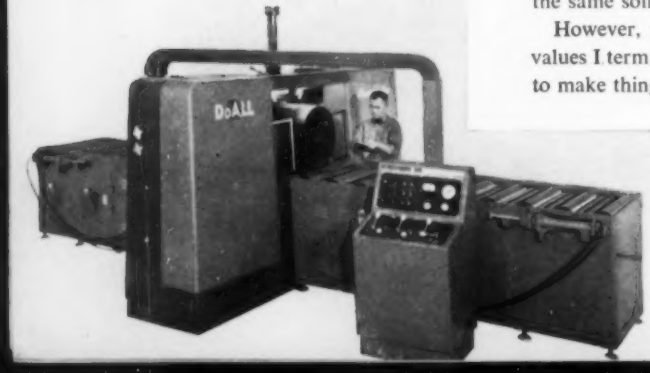
However, I doubt that this design tradition now enjoys acceptance. The shipshape ideal is accepted by some designers but rejected by others.

Another American look is the "Detroit" look. These designers have turned to the development of motorized jewelry, which has not only obscured the fundamental form of the automobile, but has begun to infect other types of products. To see what I mean, visit your local appliance dealer; many of the refrigerators and washing machines give you the feeling that you can drive them away.

There was a fairly consistent set of values developed at the time of the first settlers. These form a sort of mainstream from which many other minor streams have gone off in less-valuable directions, encouraging people to lose sight of the main current. Detroit design is one of these deviations. So were the many attempts to introduce European styles of lush decoration. So is the current Victorian craze.

The reasons are not hard to understand. The early farmer or artisan living with simple, utilitarian things and having no time for the luxury of decoration probably associated lush appearance with the wealth he hoped to achieve some day. We all know that America did achieve much of this wealth for many of its people. Paradoxically, one might say therefore, that American taste for luxury springs from the same soil as the simple, shipshape design.

However, mass production has reemphasized the importance of the design values I term the "pioneer tradition." Modern production lines find it much easier to make things out of one or a few large pieces that can be fitted together with a



DESIGN HERITAGE?

the many letters from readers commenting on this article. Because our heritage — good or bad — will affect the shape and effectiveness of many American products-to-come. **PRODUCT ENGINEERING** ***asked a group of American and foreign artists, designers, engineers and architects to give us their opinions. Here they are.***

minimum of labor. This is the antithesis of the slow, additive process of assembling a lot of little pieces into a larger whole. In other words, American products tend to be monolithic, and such monolithic forms are inclined to have the uncluttered lines of early American design . . . that is, they are uncluttered until somebody decides to paste on some chrome.

So, then, mass production gives us the means of returning to the mainstream of American design. I think this monolithic quality might be an important element in any American "look."

As for today, America has produced a fair number of designs that are very good, some that are very bad, as well as a lot that are just indifferent. Among the fields in which I think some really distinguished work has been done by American designers is that of furniture, both in the so-called "international" style, and in the more traditional types of modern, which we tend to associate with Scandinavian home furnishings. Then there are a number of kitchen utensils.

There are also fine examples among business machines, office equipment and, particularly, the handsome new computers and related data-processing equipment. There are good-looking American transportation design: ships, planes, trains, together with a few really good automobiles.

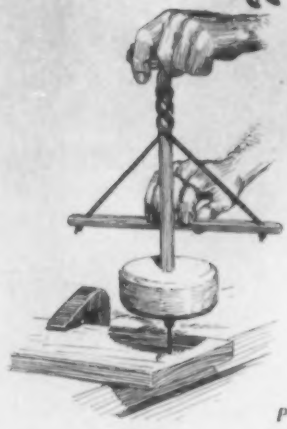
Architecture, of course, is the design area where Americans have really been in the vanguard throughout this century. I've talked almost exclusively of 20th century products in listing these categories. It is also worthwhile to look back at things like the silver of Paul Revere, the furniture of the Shakers and other "provincial" craftsmen. There are the barns of early New England and Pennsylvania.

Applying the best traditions of American design should begin with a careful consideration of the particular product's intended function. Then design it from the inside out, creating a look that expresses the inherent quality of the mechanism inside the housing. Never lose sight of the human being's working relationship to the product: the way he uses it, how it fits his own physical dimensions and how he expects it to perform for him. The product should be designed to last, to give maximum service until a better product is available—design not for planned obsolescense but rather for *genuine* obsolescense.

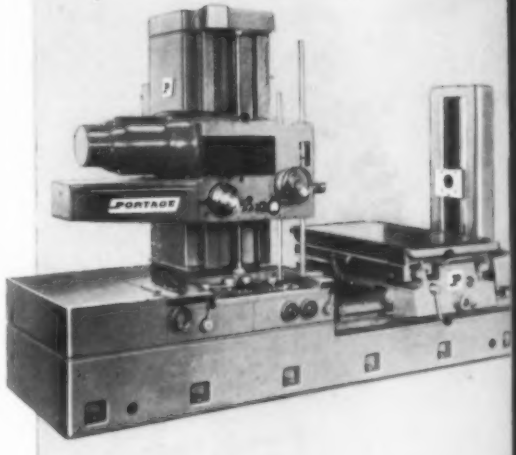
Perhaps many of my remarks imply that decoration and luxury are out of place in good design. I don't believe this for a moment. Just as simplicity can be either dramatic or dull, so decoration can seem extraneous or can make a vital contribution. Our problem is not that we have too much decoration, but simply that we have too much *bad* decoration.

Continued next page

Line drawings by Edwin Tunis

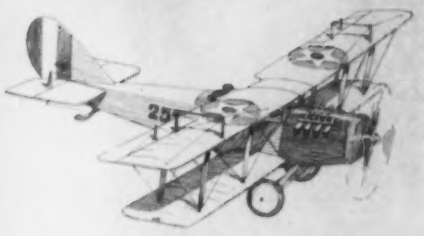


Pump drill



Lathe

Lockheed Constellation



Boeing 707

Sikorsky 5-60

• *George W. Walker* – *Vice president and director of styling, Ford Motor Co.; Trustee, Cleveland Institute of Art*

There is an American tradition of function coupled with orderly, well-proportioned shapes. Many of our early products are examples of this: the clipper ships, racing and naval vessels; cars such as the Model T and Stutz Bearcat; our Western ranch house, Cape Cod cottage; many of our farm implements. Green, an early American architect, was the first to let the structure of a house express itself. Sullivan was probably the founder of the "form follows function" theory in American architecture, and Frank Lloyd Wright was the leading exponent of that theory.

The American "look" is rounder, more unitized – a telephone, for example. There are comparable European products, but these tend to be the exception. Actually, good design tends to be international in character, although it may have been national in the past.

A number of American products have made contributions to our heritage of good design. For example, the tumblehome that was a characteristic of sailing ship hull design and which was applied to early plastic radios. This approach later affected automobiles, refrigerators, and toasters. These products, as well as most of the other creations of American industrial design, have in common a thread of simplicity. Trends in design have been largely evolutionary, because they are based public taste, which change gradually rather than overnight.

Certainly, then, I don't think American products tend to be over-decorated. I believe it is in keeping with the traditional simplicity I have mentioned.

In many areas of product design, tradition is dictated by the need for mass-produced items. Here, a product has to be designed for the average man, This means that the design of such items must seek the level of public taste.

There's one other point I want to make: America has no qualms about changing itself. The reverse is very often true in Europe.

• *Philippe Charbonneaux* – *Succeeded the late Jacques Vienot as head of the Chambre Syndicale des Estheticiens Industrielles, Paris*

Although there is a distinct look in American products compared with, say, the cleaner Italian or Scandinavian look, there is no "tradition" of universally accepted good design in America. There is, however, a deep-rooted feeling for the practical or functional.

In the late twenties and early thirties, American products were characterized by streamlined or rounded forms. Then designers started squaring off their products, and in the forties tended to use square shapes softened by rounded edges. Since 1950, rectangular shapes with sharp edges have predominated. During this evolution, many products have become more compact; volume was cut down to make products more suitable for smaller living spaces. Reaction to the square and sometimes stark forms current today may well be a return to decoration.

In this century, American designers not only closed the appearance-design gap between them and their European counterparts, but pulled well ahead of them in most fields. The American automobile has contributed most spectacularly in the search for and realization of good design – especially in the areas of interior arrangement and comfort.

Ohio River Steamer c. 1900

• *Sori Yanagi* – *Professor industrial design, Kanazawa Univ., Tokyo; arranged '58 "anti-piracy" design exhibit; Gold Medal of Triennale, '57*

With few exceptions, there are no traditions of good design in American products today. But the design of its highways and bridges are two things of which the United States can be proud. Such huge-scale construction work was only possible in a country of great wealth and advanced technology. In contrast, the appearance of American industrial products in general is not very impressive from a design point of view.

Many of these products are designed to induce people to buy – it might be called impulse design, and generally results in fashionable appearances. While people may initially enjoy such products, they soon weary of them – The American car for example. Such design practices cause defects in the products to which they are applied. This is because appearance is not directly related to the purpose or function of the product but, instead, are merely surface effects.

Among American designs I esteem highly is Charles Eames' furniture. He is one of the few maintaining the honor of the American design field. Machine tools are among other comparatively good examples of design.

I do not believe that over-decorating American products serves to advance American civilization. The blame for this tendency lies with the maker as well as the consumer, but it is the designer who bears most of the responsibility. American industrial designers are too commercial-minded.

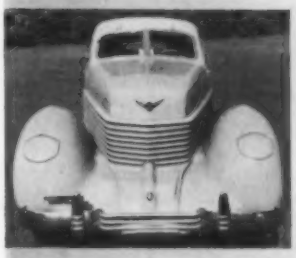
• *Olin J. Stephens II* – *Naval architect; partner, vice president, director and chief designer, Sparkman & Stephens Inc.; designed COLUMBIA, America's Cup Winner, '58*

There are examples of good American design, but to what extent they provide a "tradition" I hesitate to say. I, for one, do not feel it, and am not conscious of any broad American tradition of good design applying to a variety of American products. Perhaps this is because the designs I like run more to periods than geographical areas or countries. To some extent, I think each period looks down on the one immediately preceding it,

Until fairly recent years, there has been a healthy functionalism inherent in a great many products of a mechanical or an engineering character. Certainly this has not been true of architecture or furniture in certain times.

Although I am not aware of any particularly American product "look," I imagine the look of the American automobiles of the last few years is known – adversely – all over the world. Certainly anyone can distinguish an American from an Italian automobile today. I am inclined to think there may be certain national characteristics in other Italian products too, as well as in some of those from such countries as Germany, France and England.

I'm afraid I am not a partisan of American design, because it is my impression that those things which are the least designed are probably the best – For example, at a recent design exhibit which I visited in the Museum of Modern Art here in New York, I thought that the most interesting and attractive items were those which were purely functional, such as certain chemical utensils and electrical connection boxes. In general, those items in the exhibit which were simplest were, on the whole, the best. Certainly, the American automobile has gone to the other extreme, although there are some signs of common sense returning.

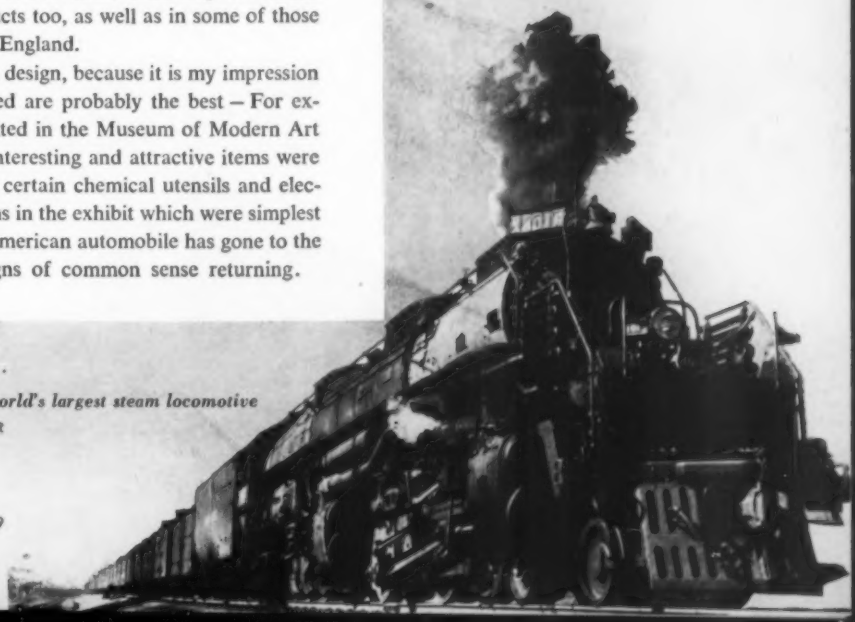


Cord

The Museum of Modern Art

Ford Model A, c. 1931

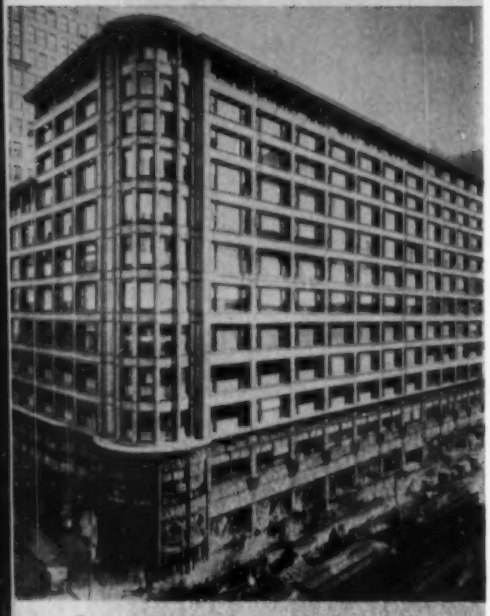
'53 Studebaker



"Big Boy", world's largest steam locomotive

Union Pacific RR

18th century "Cape Cod" house



Department store designed by Louis Sullivan

· The Museum of Modern Art

I can't say that I see any consistent progression in American products.

How American is the propensity for over-decoration? I don't know whether it is specifically American, or whether it is just the natural outgrowth of mass production for a mass market, which I suppose we have had to a greater extent, and earlier, than elsewhere. Often the least-expensive products, aimed apparently at the largest segment of the market, are the most over-decorated.

I consider functionalism as a good guide for present-day designers and engineers, but I am sure that bad functionalism is possible and good functionalism is as difficult as anything else that is really good. Over-complication and over-decoration is, of course, easy. Designing something to make it appeal to the eye is certainly desirable; designing something to make it sell seems to me entirely unacceptable – although I believe this is the object of much industrial design. I am sure the designer will do a better job if he is working to please himself..

• *Frank Lloyd Wright, 1869-1959 – Architect.*
Considered to have initiated many of the most significant architectural trends of this century

There most certainly are traditions of good design in America, primarily in architecture. This began with Louis Sullivan in the latter part of the nineteenth century, and is continued in my own work and that of other architects of the organic* school.

But I don't think we can say that there is a particular "look" to American products. This we will get by way of architecture. We also have to have a little painting, a little sculpture and some writing. I think, however, that America already has a literature of her own.

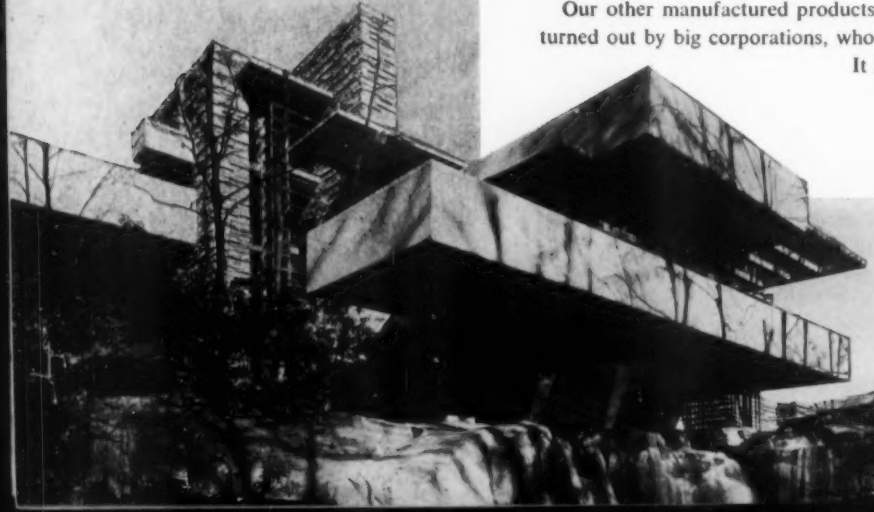
Before we can have products that look American, we must first have an architecture of our own . . . and architecture does not begin with building. It begins where building leaves off. When the mind of man wakens to the desire for beauty and the power to create it, then we have architecture. Architecture is the cornerstone of a culture, so until we have an architecture of our own, we will have no culture of our own.

The products that are providing the most opportunities for good design in this country today are primarily materials. There are the plastics, and we have also gone very far with metals – copper, aluminum, steel. These have made possible the only really modern buildings, those made of metals and reinforced concrete. I think this has given the world a new ideal, organic architecture. This is likely to be the basis of most of the other contributions we are likely to make.

There is little that is original about any of our manufactured products today, and our automobiles are a terrific reflection upon the intelligence of our country. There is nothing mobile about them; they are more like ferry boats, coming down the street gnashing their teeth at you. I think these cars show what happens when production is permitted to control what is to be available for consumption. Even if we had an intelligent demand for a particular type of car, we could not get it.

Our other manufactured products are pretty much in the same fix. They are turned out by big corporations, who employ designers they think are good.

It is difficult to say what present-day engineers and designers can do about this situation. We are now in the era of "managed" publicity. Anything that needs



· Kaufman residence by Frank Lloyd Wright

Hedrich-Blessing

publicizing to be put across can get it. And, of course, most of the currently available products must be heavily publicized to be successful. They could never succeed on the natural publicity they would obtain solely on their ability to satisfy genuine needs.

Consumer demand should be enlightened so that it will know what is worth having. The younger people – those in their teens, for example – are beginning to get hold of this, I am glad to say. They want to know about the new architecture they see all around our country. I have been receiving letters from all over this nation, from youngsters in high school. This is very encouraging and it is a good sign . . . and there is nothing "managed" about this, either!

*"*Organic architecture is a natural architecture based upon a study of nature."– Frank Lloyd Wright.*

• *Robert E. Bruckner* – *Senior Advisory Engineer, Westinghouse Atomic Power Div.; Consulting Editor, PRODUCT ENGINEERING*

Design a product so that everyone can afford to buy it. This has been America's outstanding contribution to design. It is the essence of our democratic tradition and has been continuously reflected in our design heritage. Our tradition of good design has unfortunately been too often obscured by pendulum-like swings between "over-decoration" and "just-make-it-work." Look at our architecture – overly plain Cape Cod saltboxes to overly decorated Queen Anne. Yesterday we had powerplants with polished brass gingerbread; we had overly decorated fire engines. Now we have ugly outdoor powerplants, truly beautiful fire engines, and over-decorated autos.

It is hard to single out a single American product, save ships and machine tools, that has not swung between over-decoration and stark functionalism – houses, furniture, lighting fixtures. Witness the highly decorated and woefully inefficient steam locomotives of the Civil War period as against a modern road diesel or steam Mallet-compound.

Our machine tools have always been leaders in efficiency and appearance design, and our ships have always been the most beautiful in the world. American automobiles once led the field in good design as to efficiency, cost and appearance. No longer; now they're oversize and over-decorated. Perhaps over-decoration in American design is immaturity. Strip the decoration off of a Salisbury Cathedral and you have nothing; strip the chrome gingerbread off a tool and it is not only a better, but a more beautiful object.

• *Edward C. Wells* – *vice president - general manager, Systems Management Office, Boeing Airplane Co.; Active in the design of the B-17, B-29, B-47, and 707. President, Institute of Aeronautical Sciences, 1958*

There is a universal heritage of good design and, it is available to Americans as well as others. Advantage is taken of this heritage by some designers and not by others. Nationality has little to do with it. For this reason, good American design would not necessarily be immediately distinguishable from good Italian or Scandinavian design.

Instances of good design in the U.S.A. today tend to occur among those components or products designed for economical quantity production with a specific, useful purpose in mind, and to which no totally superficial ornamentation has been added. Many American household articles, machines, buildings, transport-

Colt 44-40

Colt, Buntline Special

Harbor Freeway, Calif.

California ranch house, c. 1830

ation equipment – but few motor cars – provide good examples.

With some of these, there has been consistent progress and development, but for the majority the pattern is spotty, with good progress in design followed by retrogression, rebirth and again new progress.

Often this has resulted in over-decoration – but this is not peculiar to American design. Perhaps it appears more often in American products than elsewhere.

As long as examples of poor design enjoy public acceptance, encouraging attention to good design will not be a simple matter. Publicizing or otherwise recognizing the many successful though lesser known examples of attractively designed products might help. However, even this method might not be fully effective, because awards have been made from time to time in the name of good design without adequate consideration of the requirements.

• *George D. Culler – Associate Director, San Francisco Museum of Art; former director of Akron Art Institute; former Director of Museum Education, Art Institute of Chicago*

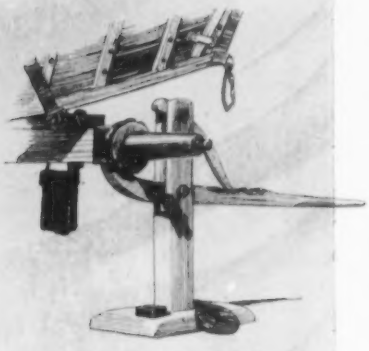
I doubt if there is any tradition, American or other, that has been accepted universally as good design. In our past however, there have been a number of design trends with coherence and continuity sufficient to enable us in retrospect to identify them as traditions – the severe and restrained tradition of fine craftsmanship of Shaker furniture.

Our direct solution to problems, unhampered by preconceptions about a "proper" use of materials or a "right" way of doing things, is linked in some way to an expanding frontier. This is thought to grow from the challenge of conquest and freedom from the shackles of a sterile tradition, i.e. the deftly shaped tools and weapons of the mid-nineteenth century, the Corliss engine and the locomotive. What is American in design can be found most easily by subtraction – take away the Scandinavian, the Italian, and other strongly national styles, and the American is what is left. But the fact that America is diverse, and does not in its design achieve the cohesiveness of the Scandinavian, is not a criticism.

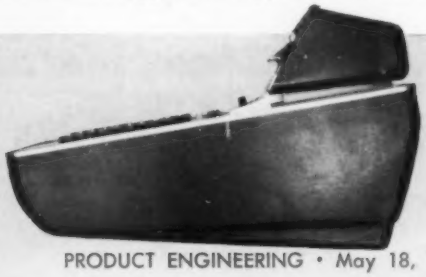
There are some positive common elements in our diversity, generosity and largeness of scale, that set ours apart from other national design tendencies. This comes in part perhaps from our wealth – more materials, more means of production, more freely available. But it comes also from an attitude of mind which is expansive and exuberant rather than cautious and restrained. This can result in designs that are grand – or ostentatious and objectionable. Unrestrained and urged on by gross motives, it saddles us with the offensive excesses of the automobile; focused and directed, it has produced outstanding architectural and engineering achievements. There has been no chronological consistency in American design. We have seen changes in design as our society has altered, from agrarian to industrial, from production-oriented to sales-oriented.

What some call over-decoration is a natural result of a love affair with material possessions relatively uncomplicated by the assertion – or at least the clear delineation – of other values. Our desires for tangible things are more clearly realized than are our desires for non-material goals. Because at this point we tend to be long on material wealth and a little short on philosophy (love of wisdom) our visual environment is characterized by more enthusiasm than sense. This is a characteristic in America now, but it is only one of many characteristics, some contradictory. And over-decoration has happened, is happening, and will happen.

Shaker table and chair
New York Public Library



Wagon jack c. 1700



The designer is wise to study the past – he attains depth, a sense of perspective, a pride in the design idea which is a bulwark against pressures – but I do not think any earlier tradition in design can be translated into solutions for today's problems. New problems must be tackled on their own terms. The question today is who shapes society, the creator-producers or the salesmen? A new era in design can emerge if designers are able to lead. But leadership cannot be assigned or legislated; its sources are inner conviction and it will emerge when designers evoke the enthusiasm of their fellow man.

• *Edwin Tunis* – *Artist and author*, Oars, Sails and Steam, '52; Weapons, '54; Colonial Living, '54; Indians, '59; *Recipient–Gold Medal, Boys' Clubs of America, Thomas Edison Foundation Award*

There's a magnificent heritage of American design: spare, clean, excellently proportioned, and almost perfectly functional. The silverware of Paul Revere, with just those qualities, is perhaps the best ever made.

The common articles of farm and home in the eighteenth century were well planned for use and were handsome. Compare an early sickle with a modern one; take a close look at a flintlock rifle or a Windsor chair.

But if there is an American look today, I'm afraid it is characterized in the eyes of the rest of the world by gaudy excess. The national characteristics in, say, well-designed Japanese or Scandinavian products were not *put* there – they *are* there because the man who designed them couldn't help their being there.

Our people have been willing to accept weird imitations of Colonial houses and furniture. Even now there is a demand for grotesque traces of this style in today's so-called "ranch houses" and "split levels." Isn't this a pathetic groping toward something national?

Perhaps the airplane is our top achievement, unless, as a visual object, it may be said to have designed itself. It doesn't try to look like anything else.

To me, a big earth-mover, which looks magnificently like what it is, is more truly handsome than any car now made.

Certainly American product design has not followed any consistent pattern of development, but there are hopes for a return to the main line. What is holding us up isn't only the addition of bad and lurid ornament. It is disregard of the normal lines of an article, dictated by its necessary parts and intended use, in favor of appearances that can bid for attention.

Unless our spirit is dead – which I won't admit – such over-decoration is not American at all. And, of course, it isn't design, which is a matter of proportion – having almost nothing to do with decoration. The eye-busting jukebox and the distorted and encrusted automobile may reflect the honkytonk shallowness that has resulted from the sudden prosperity of masses of people.

Yet mere imitation of what was good in early American products will obviously flop. An early American vacuum cleaner is not a good idea.,

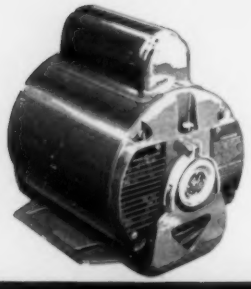
Let the modern designer be well grounded in his trade. Let him be familiar with – but not inhibited by the best, and the worst of past design, both American and foreign. Let the designer be unrestricted by the pressures of merchandising, so that he can plan a product with attention only to its use, its proportions and materials. It might even sell better than the present over-decorated creations.

But . . . where will he find a manufacturer who will make it?

Paul Revere
Antiques Magazine

Boston rocker

Paul Revere pitcher
Antiques Magazine from Yale Univ. Art Gallery



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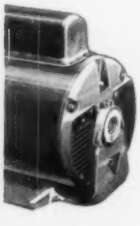
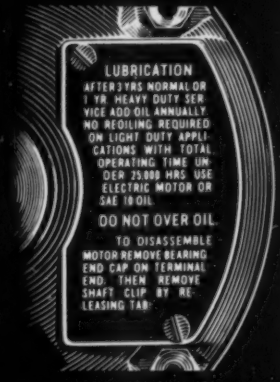


GENERAL ELECTRIC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TO DISASSEMBLE MOTOR REMOVE BEARING END CAP ON TERMINAL END. THEN REMOVE SHAFT CLIP BY RELEASING TAB

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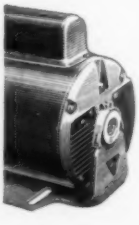
Large oil supply and superb retention system cut maintenance

Form G motors require little reoiling and on some applications no reoiling at all. This results from a 50% larger oil reservoir plus a highly efficient method of retaining oil. (On G-E ball bearing motors, a special long-life grease gives up to 10 years' service without relubrication.) Another good reason for you to choose General Electric Form G's!



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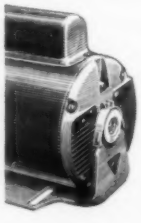

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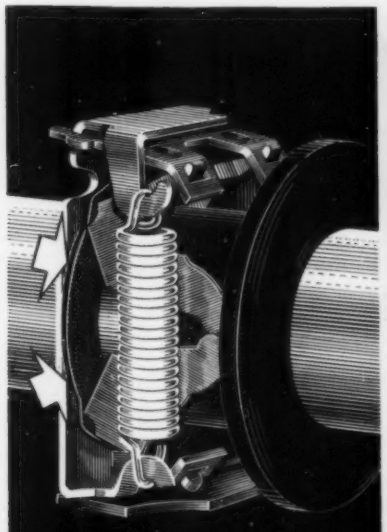

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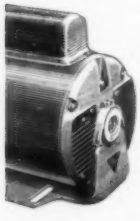

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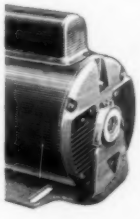

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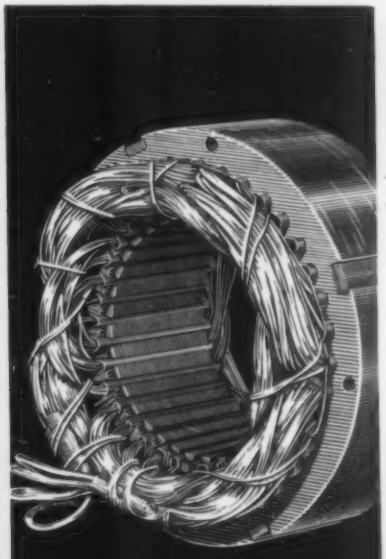

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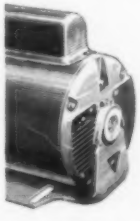

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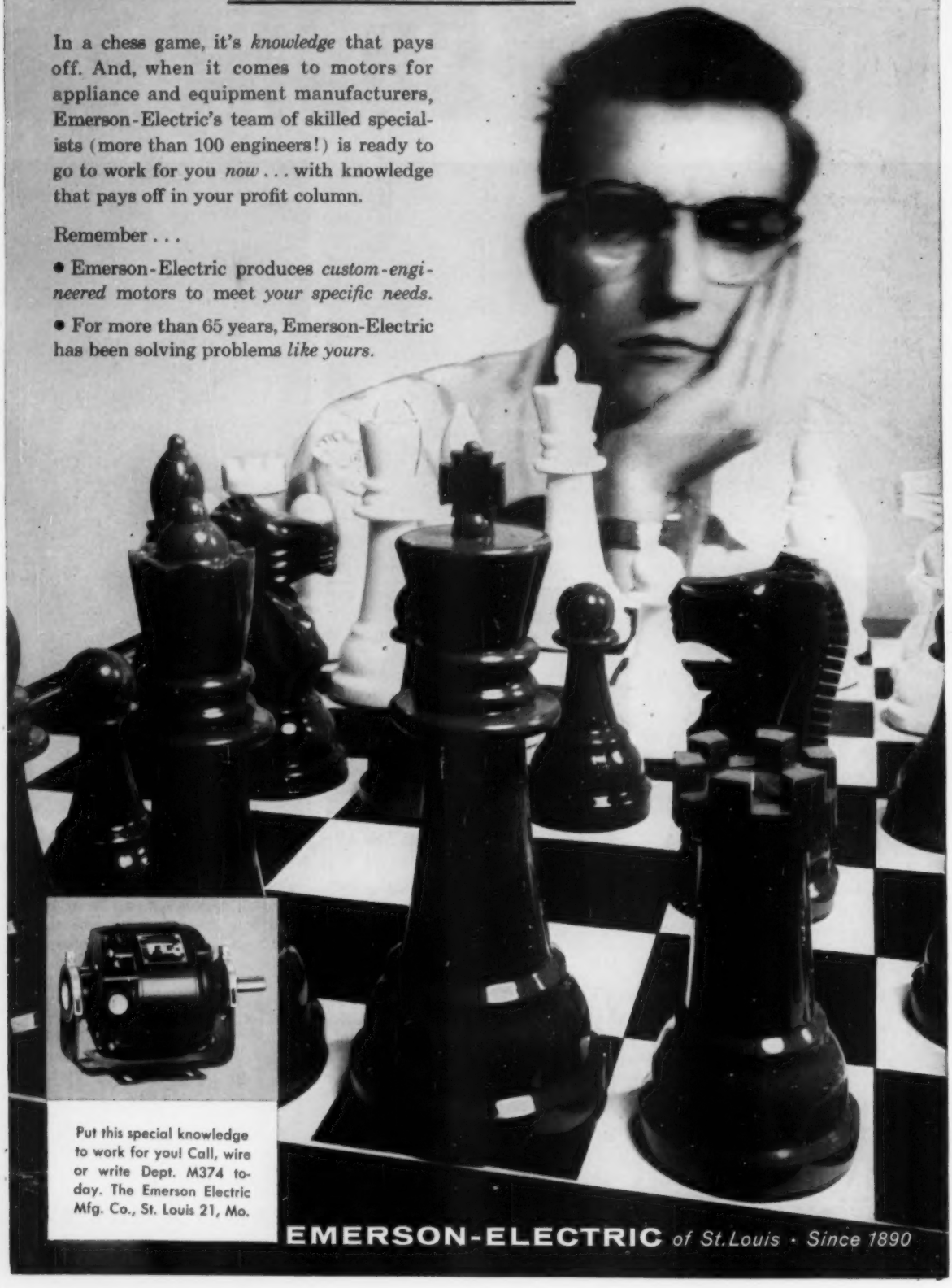

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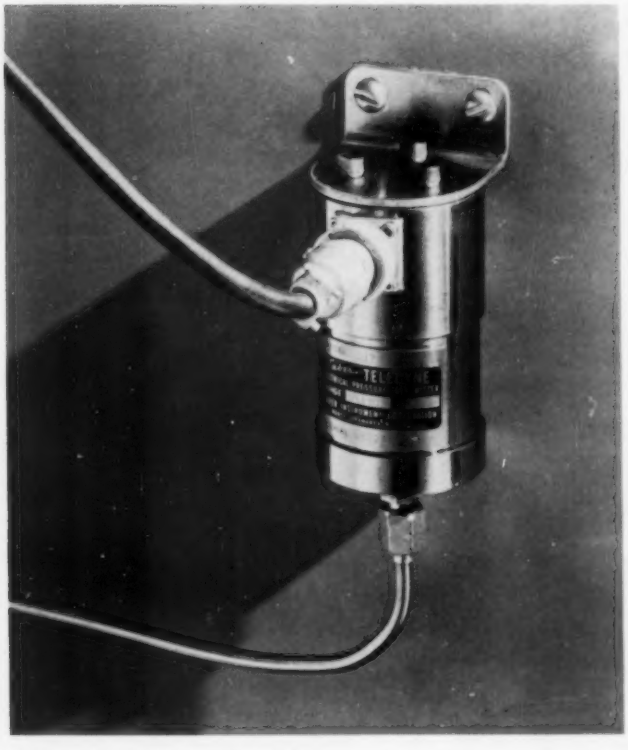

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measures corrosive gas and liquid pressures up to 200 psi. Small pressure cavity and bonded strain gage construction result in response of 1 millisec. Electrical sensing element consists of sensitive proving ring spring element with four strain gages bonded to its circumference. When pressure is applied to element, linear resistance change, proportional to applied pressure, occurs. Operates in temperatures of —150 to 250 F. Resolution is infinite; linearity 0.3%; hysteresis 0.25%; repeatability 0.1%. Pressure cavity may be cleaned without altering sensitivity or zero shift. Transducer is $350 for single unit; $370 for factory-adjusted unit matching sensitivity of precalibrated indicators, recorders and controllers. Prices, FOB factory. Delivery, 3 to 4 wk. **Taber Instrument Corp, North Tonawanda, NY.**

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Timing-belt drive . .

is suitable for wide range of load applications, from subfractional to 600 hp with torque load range from thousands of ft-lb down to in.-oz. Speeds from zero to over 16,000 fpm are possible. Constructed with steel cable cords imbedded in neoprene full-molded with nylon base fabric. Drives operate without slip, metal-to-metal contact, stretch or lubrication. Available in five pitches or distances between identical locations on adjacent teeth: $\frac{1}{5}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{7}{8}$ and $1\frac{1}{4}$ in. All $\frac{1}{5}$-in. pitch pulleys are bored to size. Pulleys conforming to other pitch sizes available include those with smooth bore and models with special bushings to accommodate various shaft diameters. **Allis-Chalmers Mfg Co, Milwaukee 1.**

Circle 13, Reader Service Card

Nonstaining finish for vinyl . . .

is offered on sheeting of 8 mil and up. Formulation developed primarily for use with white vinyl, is also available in any other color, multicolored combinations and textured effects. All stains tested are reported removable from the finish. Laminating-quality vinyl sheeting is available immediately through laminates. **Columbus Coated Fabrics Corp, 7th at Grant Aves, Columbus 16, Ohio.**

Circle 14, Reader Service Card

Indicating relief-valve . . .

signals with a red anodized pin that pops up at instant valve opens. Pin remains in out-position until manually reset, indicating preset pressure has been exceeded even after condition subsides. Valve has pressure adjustment screw on top of bonnet and can be furnished for relief settings from 3 to 100 psi. Available for NPT connections, and several tube and fitting sizes. With brass body in lots of 1 to 9, $\frac{1}{4}$ in. NPT valves are $15.28; $\frac{1}{8}$ in. units, $14.62. Delivery, 4 wk. **George W Dahl Co Inc, Bristol, RI.**

Circle 15, Reader Service Card

SMALL D-C MOTORS

1/100 TO 1 HP

Speeds: 860, 1140, 1725, 3450 rpm.

Voltages: 32, 115, 230 volts.

Windings: compound, shunt, and series.

Enclosures: for foot- or end-mounting; open, totally enclosed, explosion-proof, severe-duty, marine waterproof, Navy spraytight.

Bearings: Ball or sleeve.

Special ratings and speeds also available.

Features: Long life, high efficiency, quiet operation because of close tolerances, dynamic balancing, and spirally stacked punchings.

FREE BULLETIN Write to Section 634-21, Schenectady, N. Y. **GENERAL ELECTRIC**

CIRCLE 71 READER SERVICE CARD

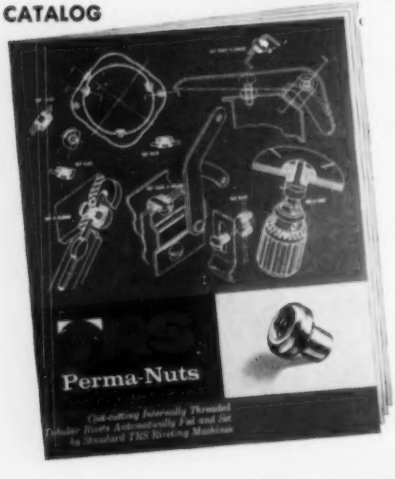
ATTACHMENT and FASTENING

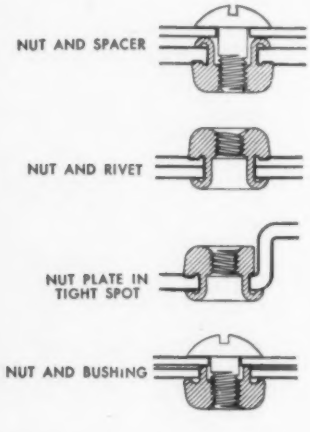
PROBLEM SOLVER

Applied with standard TRS riveting machines

Solve design problems with PERMA-NUTS and get the speed and economy in production that goes with automatic feeding and setting of standard tubular rivets. An important advantage of this unique combination nut and rivet! A built-in "lock washer" feature is another.

WRITE FOR CATALOG





TUBULAR RIVET & STUD CO., *Quincy 70, Mass.*

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Spring mount for machinery . . . isolation has all-rubber housing that reduces noise transmission and is, therefore, particularly applicable where noise is as great a problem as vibration. Mounting, which uses steel springs as vibration- and shock-absorbing medium, can carry loads from 150 to 1400 lb per isolator. Min operating height is 4 in. Opposed S-slots in base permit removal from an installation by a 45° turn. **Korfund Co Inc, 48-19C 32nd Pl, Long Island City 1, NY.**

Circle 16, Reader Service Card

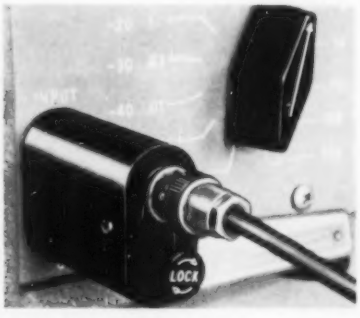
Current-sensitive switch . . . is one-shot device for use in circuitry testing, bypassing squibs, protective devices and current-operated triggering devices. Hermetically sealed, normally open and closed SPST switches are rated 1 amp min for firing (closing time dependent upon applied current) and 2 amp max for switching (closing time, 1 millisec to 5 sec). Fuse resistance is 1.35± 0.15 ohm; contact resistance is less than 0.3 ohm; insulation resistance, 200 megohm min, before and after firing. High potential is said to be 600 v rms at 60 cps at sea level. Operates in unlimited altitudes at temperatures of −100 to 750 F continuous or 1000 F for 30 min. **Thermocal Inc, 1627 Colorado St, Santa Monica, Calif.**

Circle 17, Reader Service Card

Water-removable coating . . . is said to provide scratch-resistant, temporary protection to aluminum, stainless steel and magnesium while in transit and during production op-

erations. Opaque coating air-dries to 80B Rockwell hardness in 30 min. under normal conditions and does not impair markings or make them invisible. Supplied in neutral form, coating may be colored for identification by water-soluble dyes. Said to be nonreactive, inorganic coating, to resist petroleum solvents, and to withstand mild forming and shaping. It is not intended to withstand severe angle forming. May be applied with conventional equipment for spraying, dipping, flow-coating, roller-coating or pressure-curtaining. Removes with warm water, except when material has been coated for longer than 6 mo, in which case steam cleaning is recommended. Covers 1000 sq ft per gal. with coating that averages 0.001 in. thick. Weighs 11.25 lb per gal. **Industrial Metal Protective Inc, Dayton, Ohio.**

Circle 18, Reader Service Card



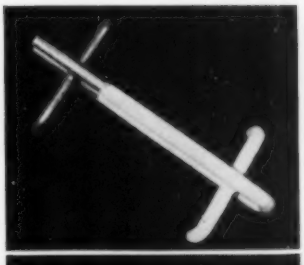
Locking adapter . . .
in BNC or UHF models, locks on to standard binding posts on ¾-in. centers for positive connection of electronic instruments in complex test setups. Approximately one-half turn of lock screw expands a plated spring steel banana pin within binding post, securely locking adapter in place and preventing erratic contact. Shielded models reduce noise and hum. Unshielded models mate securely to 3-terminal post assemblies. Units are Teflon-insulated. Price for 1 to 49 adapters is $7.50 each, FOB factory. **Highland Electric Co, 1130 Mission St, S Pasadena, Calif.**

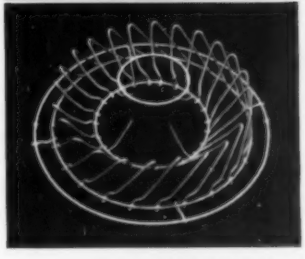
Circle 19, Reader Service Card

Teflon tube fittings . . .
in all standard shapes and sizes, are available for ⅛ through 1 in. OD tubing. **Crawford Fitting Co, 884 E 140 St, Cleveland 10.**

Circle 20, Reader Service Card

COATING STEEL?





Reynosol Can Do It Best!

There's a special Reynosol formulation for your coating problem. And if it's steel you're coating you'll be interested in the extra benefits that only Reynosol can offer you.

What are they? Greater resistance to temperature . . . truest color control . . . greater tensile strength . . . lower total cost.

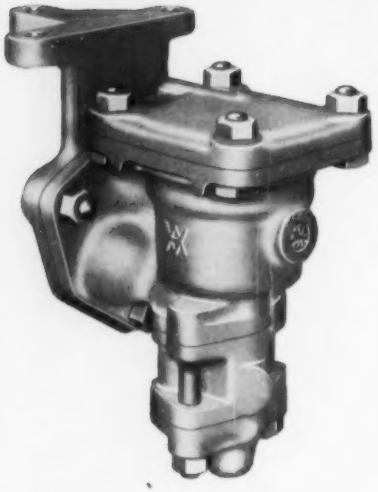
Let Reynolds Chemical show you —specifically—how Reynosol can do *your* coating job better.

REYNOLDS CAN COAT IT — IF ANYONE CAN!

REYNOLDS CHEMICAL PRODUCTS COMPANY

Whitmore Lake, Michigan • Phone Hickory 9-9361
DIVISION OF STUDNITZ GREENE CORP.

Typical Control Functions solved by AIR CIRCUITRY



● The H-5 RELAYAIR Valve, one of many Westinghouse Air Circuitry Components, is a pilot operated, directional control valve. It may be normally open or normally closed, depending upon port connections.

Various spring settings provide operating pressures from 3 to 150 psi. An easily removable pipe bracket permits removal of valve without disturbing pipe connections.

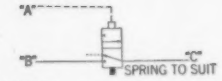
Envelope size: 7¼" x 7⅜" x 4⅜"
Maximum supply pressure 200 psi.

Typical Applications—In addition to the illustrated functions, this highly versatile valve has been and can be used in all conceivable types of air circuits. Some of these are as follows: cycling operations, safety interlocks, low pressure alarm signals, emergency cut-off of power, emergency brake applications, remote control station relays, sequence control timing, and many many others.

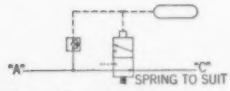
If you have a control problem, let us know about it. It can probably be solved with Air Circuitry. For more information, ask for Catalog A5-81.01.

What is air circuitry?

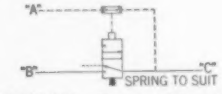
This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise Air Circuitry is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will help you boost production and cut costs in your plant or shop.



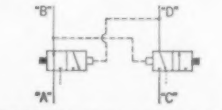
1. RELAY—To increase flow or pressure in an air circuit. An air signal directed to line "A" overcomes a spring opposed diaphragm to connect line "B" to line "C." Various spring values determine operating pressure.



2. TIME DELAY—To provide automatic power unloading. Air signal pressure in line "A" flows through the device to line "C" to perform specified operation. A check valve with choke and a volume provides a time delay by requiring a predetermined pressure be built up before line "C" is vented to atmosphere.



3. LOCK-UP—To provide a hold-in feature. Air signal in line "A" connects line "B" to line "C." Air from line "C," through a shuttle valve, holds this connection when signal air is vented.



4. CRISSCROSS INTERLOCK — To prevent energizing one line before another is vented. With lines "A" and "B" energized with air pressure, line "D" is vented to atmosphere. Line "D" cannot be energized until line "B" is vented. The converse is true when lines "C" and "D" are energized.

5. SEQUENCE INTERLOCK—To insure one function is performed before another is initiated. Line "A" must be energized to a predetermined pressure before line "B" can pass air to the next function.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

WESTINGHOUSE AIR BRAKE COMPANY
INDUSTRIAL PRODUCTS DIVISION, WILMERDING 6, PENNSYLVANIA

SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .

Key-operated motor starter . . . fits any standard single-gang outlet box. Single-phase 115/230-v starter is for direct operation of motors through 1 hp. Available in open or NEMA 1 surface-mounted enclosures. Can be furnished in single or double-pole design. Incorporates straight-through wiring and plug-in heater. Manual use of key in starter permits only authorized operation of equipment. One key fits all GE-operated forms. Enclosures can be furnished with or without 115/230-v neon indicating-light mounted above toggle switch. This light requires no additional wiring, as printed circuit is used in enclosure cover. Nameplate is supplied with open-type starters for identification where other flush-mounted equipment is used. **General Electric Co, Schenectady 5.**

Circle 21, Reader Service Card

Inertia switch . . . energizes electrical circuit for actuating equipment if g-loading reaches preset values for predetermined interval. Basically, switch consists of pendulum that is restrained along arc by spring. When g-load exceeds preset value for designated min length of time, pendulum swings across gap and makes contact with electrical circuit. Hermetically sealed switch is set, before sealing, for operation at magnitudes from 0.25 to 10 g within time setting between 0.01 to 10 sec. Switch withstands vibrations to 500 cps and to 10 g. Operates on 12 to 30 v dc. Relay contacts are rated 3 amp resistive. 3½x2⅛x2⅛-in. unit weighs 0.85 lb. **Walter Kidde & Co Inc, Aviation Div, Belleville, NJ.**

Circle 22, Reader Service Card

Some Ideas

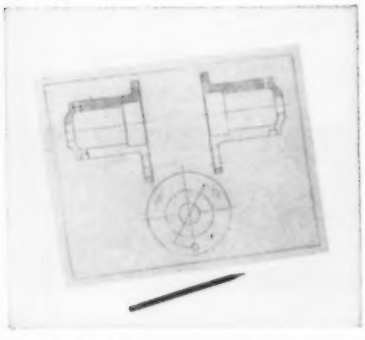
for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

A year of relentless testing has produced a small library of interesting facts about HERCULENE (T.M.) Drafting Film. What follows is a consensus of drafting-room experience with HERCULENE—by K&E and its customers—with some up-to-date recommendations for using it. Take the matter of . . .

Shiny Back vs. Pencil Back

A basic question is: do you need a double-surfaced drafting film? We make HERCULENE Drafting Film both ways, of course—with a single surface (shiny back) and double surface (pencil back). It's our recommendation that you use pencil back HERCULENE only if it's your practice to make basic drawings on one side, changes on the other. For most other uses, shiny back is preferable. (At first, the double-surface film was chosen by many drafting rooms because it lay flatter on the board than shiny back. This is no longer true. K&E research labs have come up with a fully effective anti-curl treatment.) Especially in filing, shiny back HERCULENE presents fewer problems. The clean non-abrasive back won't smudge the face of the sheet underneath, even in a heavy stack of tracings. If you'd like to compare a few sheets, please let us know.



Note sharp clear lines made by Duralar pencil on HERCULENE Drafting Film.

Plastic Pencils and the HERCULENE Surface

Not just a handy catch-phrase, when K&E puts its exclusive "engineered surface" on a drafting material, the result is an exact, uniform tooth for sharp pencil drawing, inking and typing. With HERCULENE Drafting Film, however, an entirely new type of plastic (non-graphite) pencil yields especially good results. Quite a few of our customers have reported favorably on the well-known Staedtler "Duralar" brand. Duralar pencils come in five hardnesses, are non-smudging and have generally good covering power, sharpness and erasability. After about 20 prints, the Duralar lines show up consistently better than those made by a regular pencil, since graphite lines tend to lose density.

Wet That Eraser!

The erasing qualities of HERCULENE Drafting Film are excellent, but (as with the pencils) we've discovered it's a new type of vinyl eraser that gives the best results. Examples of these non-rubber type erasers are the Richard Best "TAD" and the Eberhard Faber "RACE KLEEN"—both available from your K&E dealer. With vinyl erasers, pencil lines whisk off. Even stubborn ink and typing can be removed easily, with no damage to the surface. Here's a tip on how to do this:

Moisten the eraser slightly. It becomes no more abrasive, but a lot more "erasive." Moistening is a must when removing Duralar lines or typing after exposure to heat. (Incidentally, don't use electric erasing machines, steel erasers or typewriter erasers.) When erasing large areas, certain chemical eradicators work fine too. Our suggestion: use Vythene or a very light application of a denatured alcohol such as Solox, both of which can be applied with a cotton swab or clean cloth.

The Cleaner the Better

HERCULENE Drafting Film was designed for ink work, and its ink take is unexcelled. But like all films, its non-absorbency makes a few preparations advisable. The surface should be cleaned thoroughly before inking. Quickest and most effective way to do this is with the ABC Draftsman's Dry-Clean pad, which will remove finger marks and "traffic film" simply by rubbing the pad over the surface. Pouncing will also work well. A damp cloth is all right for general cleaning, but does not do the best job of preparing the surface for ink.

Inking over graphite pencil lines comes out best when done over light lines, drawn with a harder grade of pencil. A good way to remove excess graphite is to go over the drawing with an ABC pad. Inks vary in their usefulness on HERCULENE. We've tested several, and you're welcome to these results as well, on request.

After Typing, Please Pounce

Typed impressions on HERCULENE Drafting Film are crisp and sharp, but may take a while to dry because the film's surface doesn't "swallow" ink readily. A light pouncing right after typing will dry the ink and fix the lines—giving you uniform permanent contrast.

A new typewriter ribbon will produce the best impressions. At K&E we've tested a healthy variety of ribbons and we'd be pleased to send you the results on request.

Outstanding Advantages Proved in Tests

We're pleasantly amazed at the short time it took for HERCULENE Drafting Film to become an accepted "staple"—along with ALBANENE® Tracing Paper and PHOENIX® Tracing Cloth. Actually, it's a rare drafting room by now that has *not* tested HERCULENE during its first year on the market. The findings: All properties considered, HERCULENE stands up better than any other drafting film. It has great resistance to heat, aging and abuse. Its exclusive "engineered surface" plus its tough, durable Mylar® base provide superior pencil and ink take, fine erasability, remarkable dimensional stability...a combination we're proud to call unbeatable!

The K&E dealer near you has HERCULENE now. Stop in and see him.

KEUFFEL & ESSER CO., Dept. PE-5 Hoboken, N. J.

Please send further information about HERCULENE Drafting Film. I'd like samples too.

Name & Title _____

Company & Address _____

_____

2001

PRESSURE SWITCHES

for twice-a-second or twice-a-year operation!

An Oil-Dyne pressure switch has repeatability—it will function properly every time, whether it operates several times a second—or once every six months! Liberal use of low-friction materials and a completely new (patent applied for) design that eliminates all contact between O ring and cylinder walls combine to keep piston from sticking—assures perfect operation every time, any time. 50-5000 psi, explosion-proof. Single and duplex models. For hydraulic fluids and gases (freon, oxygen, etc.). Write for illustrated brochure.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION

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- ACCESSORIES

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CIRCLE 76 READER SERVICE CARD

MICROBEADS®

a new Insulating Material

Microbeads are microscopic glass beads available in a wide range of mesh sizes. They are highly resistant to the passage of heat and are virtually unaffected by moisture. In addition to these characteristics, Microbeads possess a fascinating array of physical and chemical properties that make them an ideal insulating material. Once you've seen them . . . worked with them . . . you'll discover they have a vast potential for other applications as well. Microbeads could be the answer to your particular problem. Free samples and technical data are yours for the asking.

M3A

MICROBEADS, Inc.

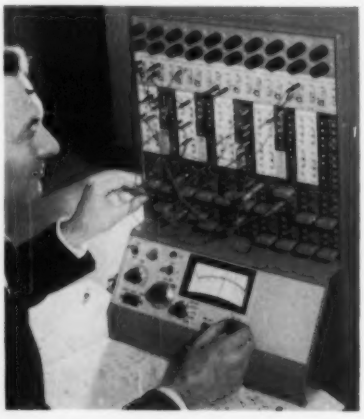
P.O. Box 241/Jackson, Miss.

Microscopic Glass Beads for Industrial and Reflective Purposes

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Slige gage—ball point pen . . . combination has scale for inches and centimeters and pushbutton for pen. Sliding pocket-clip acts as caliper for measurements. Chromium-plated pen is available with firm name or slogan. Individual pens, gift boxed, are $7.95 postpaid (plus tax in Calif). Designs Modern, 4082 El Bosque Dr, Pebble Beach, Calif.

Circle 23, Reader Service Card



Low-cost analog computer . . . is said to be able to perform 95% of routine mathematical operations encountered in normal design calculations with accuracy of 0.1%. Enables engineer to perform electronically mathematical operations of addition and subtraction, multiplication and division, integration and nonanalytical function generation with which he can solve routine design calculations in a fraction of the time required without computer methods. In problems where a constant value is desired solution, transistor-equipped computer can be used without readout equipment. Solution can be read to three-place accuracy. Where dynamics are involved, readout equipment for numerical or graphic presentation of solution is recommended. Computer, which is 15x17x24 in. high, occupies little more than desktop area required by standard electric typewriter. Weighs 80 lb without accessories. Basic unit price starts under $4000; readout equipment ranges in price from $1350 to $1900. Available after June 1. Electronic Associates Inc, Long Branch, NJ.

Circle 24, Reader Service Card

EMPLOYMENT OPPORTUNITIES

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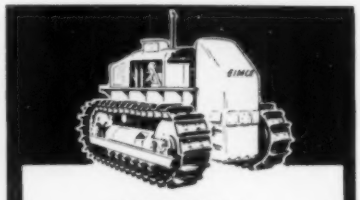
The advertising rate is $21.20 per inch for all advertising appearing on other than contract basis. Frequency rates quoted on request.

UNDISPLAYED RATE

$2.10 per line, minimum 3 lines. Position Wanted ads in this style, ½ the above **rate. To figure advance payment count 5 average words to a line.**



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Earthmoving experience, with successful record in design and development of heavy mechanical equipment, crawler tractors, bulldozers, winches and tractor attachments.

Work includes layout and design of heavy machinery for construction and mining.

Permanent positions open, for those qualified, with one of the nation's fastest growing heavy machinery manufacturers.

Location -- Salt Lake City, Utah -- in the mountain West, where you can breathe clean air, and drive from home to work in less than 20 minutes.

Send Complete Information and photograph to Dept. SXB

THE EIMCO CORPORATION

P. O. Box 300, Salt Lake City 10, Utah

B - 438

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Desire opportunity in architectural development. Graduate, experienced architect with background in plastics development. Currently construction supervisor. Resume upon request. PW-1606, Product Engineering.

M.E. desires change of employment. Would consider position where knowledge of foreign languages (Germ., Russ., Swedish) could be utilized. PW-1692, Product Engineering.

***When Answering* BOX NUMBERS . . .**

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

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NEW LITERATURE

Physical Laws and Effects

C F HIX, JR and R P ALLEY. John Wiley & Sons Inc, 440 Fourth Ave, New York 16. 6 x 9¼, 291 pp. $7.95.

This guide to common and uncommon phenomena and related scientific theories has been compiled specifically for engineers such as those engaged in research and product development. The authors have combed not only current literature but also first editions of early scientific books, periodicals and other publications. The data on each effect and law is presented in a short description, an illustrative example, the magnitude of the phenomena involved (often in the form of an equation), some useful bibliographical references, and a listing of the quantitative forms in which the phenomena involved may be observed.

Three different cross-reference systems are provided: 1) by laws and effects, according to the most popularly accepted name or names; 2) by fields of science; 3) by physical quantities (such as absorption, charge).

In an introductory chapter, Mr Hix describes several ways in which the book might be applied by an engineer to design problems. He even cites an example of how a search of known laws and effects was successfully applied to product development.

An addendum presents many additional laws and effects in abbreviated form which could not be included in the main text. These include items of comparatively recent development or which were brought to the authors' attention too late for research into background and accuracy. —*JK*

Color Planning for Business and Industry

HOWARD KETCHAM. Harper & Bros, 49 E 33rd St, New York 16. 174 pp, 6½ x 9⅝. $5.95.

The summary of the color stylist's techniques has one chapter on the selection of color systems for manufactured products.

PURCHASING TEST INSTRUMENTS—Brochure, 8 pp. Describes directory of standard electronic test instruments and manufacturers, with specifications and prices, and custom instrument service. Technical Information Corp, 41 Union Square, New York 3.

Circle 1, Reader Service Card

CAPABILITIES—Booklet, 19 pp. Covers facilities and types of service that Research Laboratories Div is prepared to render in applied research, product development and testing. Flexonics Research Laboratories, 840 N State St, Elgin, Ill.

Circle 2, Reader Service Card

POCKET-SIZED TECHNICAL BOOKS—1959 Catalog, 52 pp. Data index of engineering and business books available. Books contain about 140 looseleaf pages of material. Subjects cover most phases of engineering. Lefax Publishers, 9th & Sansom Sts, Philadelphia 7.

Circle 3, Reader Service Card

ELECTROLUMINESCENT LAMPS—Booklet, 4 pp. Lists available lamps in standard sizes from 2 x 2 to 24 x 24 in. Contains technical data and graphs covering lamp operating frequency, voltage effects and maintenance. Sketches suggest applications. Westinghouse Electric Corp, Lamp Div, Bloomfield, NJ.

Circle 4, Reader Service Card

FILAMENT-WINDING PROCESS—Booklet, 8 pp. Covers engineering and production aspects of fiberglass filament-winding, characteristics and physical properties of structural material, end products and facilities and personnel available for application engineering. Young Development Div, Hercules Powder Co Inc, Rocky Hill, NJ.

Circle 5, Reader Service Card

DRAFTING EQUIPMENT AND SUPPLIES—Catalog 159, 100 pp. Describes drawing tables, plan files and drafting room furniture, templets, and a variety of other supplies. Alfred Mossner Co, 108 W Lake St, Chicago 1.

Circle 6, Reader Service Card

CERAMIC PROPERTIES—Chart 591. Represented are the frequently used compositions. Includes tabulated properties, selection charts, graphs. American Lava Corp, Manufacturers Rd, Chattanooga 5, Tenn.

Circle 7, Reader Service Card

TEFLON PUBLICATION—Vol 1, No. 1. Product engineering and application considerations of Teflon resins are subjects of "Plastips," a new bulletin that made its debut in February. Engineers and technical management personnel can receive monthly bulletin without charge, upon request. Tri-Point Plastics Inc, 175 I U Willets Rd, Albertson, LI, NY.

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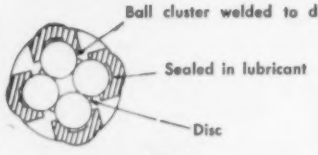

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Publisher's Postscript...

who's to REPLACE him?

Architects tend to think their influence on civilization is greater than that of all other arts combined. I'm not convinced of this, but you can't deny that their works cover more and bigger chunks of landscape than paintings, literature, automobiles and refrigerators ever will. Architecture has some pretty good records for long life, too.

And the man casting the longest shadow among architects was Frank Lloyd Wright. You have read his comments on American design in this issue. He had opinions and he wasn't afraid to express them.

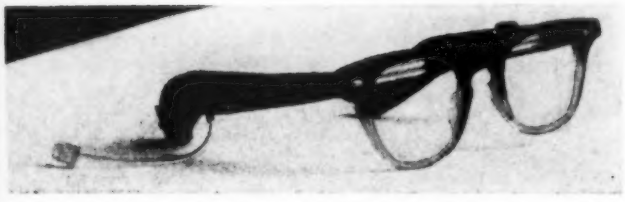
Mr. Wright had no trouble with false modesty, either. He said flatly that he was America's greatest architect, which I suspect may be true. Certainly he was our most daring and original one. At 89 he had more courage than any 30-year-old and more earthy common sense than Mark Twain.

I say we all have something to learn from him—as engineers (take a look at the Imperial Hotel in Tokyo), as designers (what takes more human engineering than a home?) and as men (Mr. Wright lived more in his 89 years than most of us could in twice that).

It was good to know there was a Frank Lloyd Wright around—stirring things up, thinking, writing, dreaming and building extraordinary and beautiful museums, churches, homes. He changed our image of what's "right" and "proper" design a thousand times.

Now he's gone, and who's to replace him? —AH

For Your Information (personal)



Need glasses?—listen to these

Why not a tiny, very private radio like one of those hearing aids that look like eyeglasses? Why not indeed? And the Japanese manufacturer who designed the eyeglass radio is marketing it at the surprisingly low price (US equivalent) of $17 a pair (supply your own lenses if you must have them). It has three transistors and a germanium diode, is powered by a mercury battery. Switch, volume control, and earplug are located at the end of the right temple bar; a knob on the other bar serves as tuner. It will bring in 5 stations, says the manufacturer, Kowa Trading Co, Tokyo, and has a range of 62 mi. Now being developed: a unit incorporating both solar and nickel-cadmium batteries that "can be used day or night."

When moths eat synthetics

You can have moth problems even with the "mothproof" synthetic fibers, says the National Institute of Drycleaning, if you tempt the little insects with tasty tidbits. Moths and carpet beetles, they find, will eat right through nylon, rayon, acrylic and polyester fabrics if they're spotted with such delicacies as tomato soup and chicken stew. The NID moral, of course: Never store garments without having them drycleaned first. The broader implication, though, is that the best of materials can have its properties changed or its advantages destroyed by improper selection of coatings and impregnants. That often happens with materials normally resistant to flame and fungus damage. (More on this aspect of the problem will be found in forthcoming issues.)

But how fast is up?

From the skyways to your car comes a full-range recording accelerometer that "measures up to a full g"; and, its manufacturer says proudly, costs no more than those with only ½-g capability.

Furthermore, the instrument "helps determine horsepower and indicates to the driver just what fuels, ignition and carburetion adjustments, tire pressures and throttle settings give him the best results." It has a silicone damping system; and "operates under any temperature conditions."

The price: $21; from Genisco Inc, PO Box 668, El Monte, Calif.

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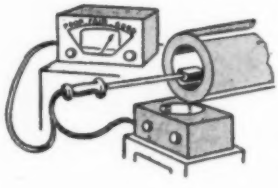
Why Don't They

RESEARCH and DEVELOP . . .

Here are four problems encountered by the armed forces. If you've got a solution, type it out and mail to: The National Inventors Council, Office of Technical Services, US Dept. of Commerce, Washington 25, D. C. Keep a carbon for your files.



. . . a non-destructive means of testing the bond between chrome plate, or other electrodeposited metal, and the base material. One application for this device would be for testing the adhesion of chrome plate in the bore of a cannon. Destructive tests (in which plated sample is subjected to repeated bending, sudden tensile strains, shot peening or penetrating with a Brinell ball) are not suitable in such situations. Present method of testing cannon bore is by proof firing and visual inspection. Ultrasonic tests may be an answer but whatever the technique, it must give quantitative or comparative results.

. . . A diaphragm-type hydraulic accumulator which will not allow gas to diffuse through the diaphragm at pressures up to 2000 psi—but flexible enough to allow at least 200-cu in. displacement of oil. Accumulators in which a piston separates oil from compressed nitrogen are now used in applications where a diaphragm type would be preferred if it were more reliable. But diaphragms occasionally fail by extruding into the hydraulic fittings and by rupturing. These failures have not been the sole fault of the diaphragm but also of general accumulator design.

. . . a method, material, or combination of materials for converting light energy directly into magnetic energy without the intermediate step of electrical energy. This would simplify the equipment for recording images on magnetic tape.

. . . a simple device for determining the dew point of compressed air. This will be used to indicate whether compressed air in missiles is sufficiently dry to avoid freezing of air valves. To be suitable for field use, the instrument must be lightweight (50 lb), portable, and capable of operation without external power supply. It should have a working range of −110 to 20 F at atmospheric pressures and an accuracy of ±1.5 F.

Have you a problem, based on known scientific principles, which seems to have an answer somewhere within the limits of present technology? To inspire inventors along worthwhile paths, PRODUCT ENGINEERING invites you to trade such problems with fellow readers who may have a fresh viewpoint or more time for the necessary R & D. We will pay $10 for each one accepted.

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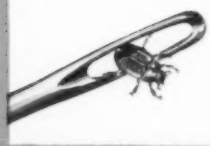

Smallest of the Small. A pigmy beetle could easily crawl through the eye of an ordinary sewing needle, as shown by this equally magnified view of both. Among the tiniest of insects, some species of pigmy beetles reach about one-hundredth of an inch in length.

Miniature for Missiles. This tape recorder, shown one-sixth actual size, is a vital unit in the communications system of the Army's "talking satellite." Constant low-torque and quiet operation of MPB bearings in it maintain accurate tape position.

Man with Miracles. Like all MPB Sales Engineers, Dean Skillin makes a practice of showing people how small, precision-made MPB bearings reduce maintenance, increase economy, and solve miniaturization problems. He's ready to do the same for you.

Miracles in Miniaturization

ACTUAL SIZE OF THE MPB BEARINGS IN TAPE RECORDER SHOWN ABOVE

Little Things That Count. There's nothing new, in the larger sense, about ball bearings. But miniaturization of these familiar components is a wholly modern development. Forty years ago, for example, MPB was first to manufacture bearings with O.D.'s as small as $\frac{3}{8}''$, and with precision that brought new aid to science and industry. Today, after continual pioneering in miniaturization, MPB produces over 500 types and sizes of bearings, ranging down to $1/10''$ O.D., with specials as required. Our catalog brings you details on these bearings. Write for it, or for engineering advice, to **Miniature Precision Bearings, Inc.,** 206 Precision Park, Keene, N.H.

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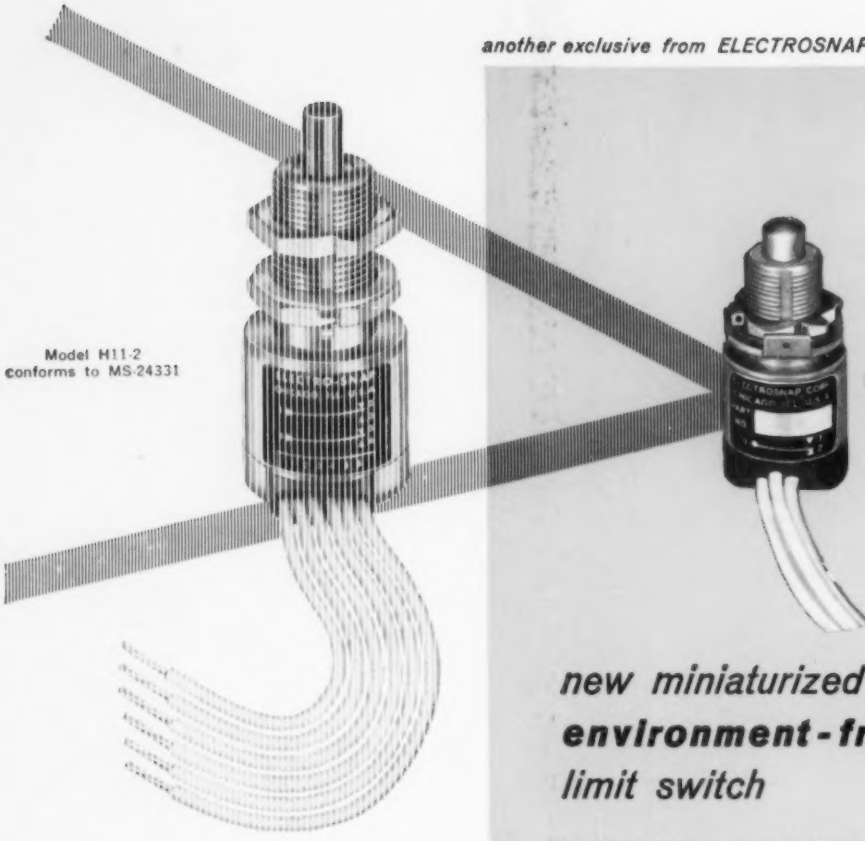


Model H11-2
conforms to MS-24331

New Model H11-20, actual size

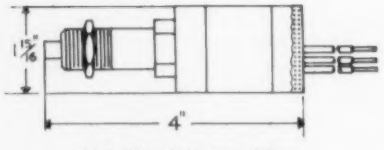
new miniaturized **environment-free** *limit switch*

It's 40% smaller than the MS standard . . . only ¾" in diameter, 1½" high. Has these features of sealed switches which conform to MS-24331: single-hole mounting, "O" ring sealed plunger with built-in scraper to prevent jamming by ice or dirt, and epoxy sealed leads. This construction meets the requirements of immersion test, MIL-E-5272-I.

Switch has unusually high electrical capacity for its size: 6 amps @ 125/250VAC/30VDC resistive, 2.5 amps @ 30VDC inductive. Meets electrical capacity tests in 70,000-ft., —65° atmospheres. Circuit is S.P.D.T.

Unit is light-weight (only .1 lbs.), yet rugged enough to withstand 100 lbs. pressure in any direction. Case is silver-brazed for stronger, more positive seal. Corrosion-resistant materials used throughout; body, bushing and push-button plunger are stainless steel.

This switch is now used on commercial jet aircraft and is recommended for use in any environment on missiles, machine tools, military aircraft, etc.



Triple-Pole Environment-Free Push-Button Switch

Model H11-24 simultaneously switches 3 circuits, has MS-type configuration. Electrical rating: 15 amps @ 125VAC/30VDC resistive, 10 amps @ 30VDC inductive. Weighs 9 oz. Meets requirements of MIL-E-5272, procedure 1 immersion test. Write for details.

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Write for new technical literature and specifications on environment-free switches.

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